SEWAGE WORKS JOURNAL

ANNUAL DIRECTORY NUMBER

VOL. XXI MARCH, 1949 NO. 2

Special Features

Review of 1948 Literature—Research Committee

Allegheny County Sanitary Authority—Laboon

Industrial Waste Surveys—Weston, et al.

Stream Recovery Factors—Velz

1949 Yearbook and Directory

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OF THE

FEDERATION OF SEWAGE WORKS ASSOCIATIONS

IN CONJUNCTION WITH

NEW ENGLAND SEWAGE WORKS ASSOCIATION

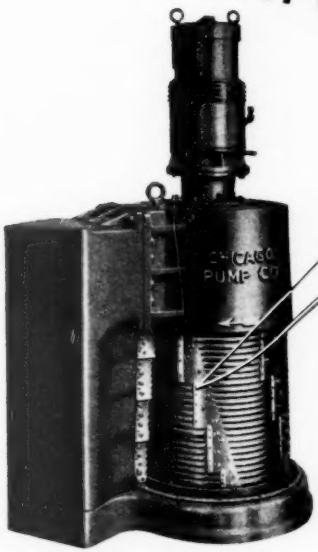
STATLER HOTEL

BOSTON, MASS.

October 17-20, 1949

FEDERATION OF SEWAGE WORKS ASSOCIATIONS
325 ILLINOIS BUILDING CHAMPAIGN, ILLINOIS

YOU CAN'T CUT WITH HALF A SCISSOR



The 25A COMMINUTOR. This machine will handle flows averaging up to 10,000,000 gallons a day when set in a channel of proper design. The scissors point to the shear bars and cutting teeth on the slotted drum.

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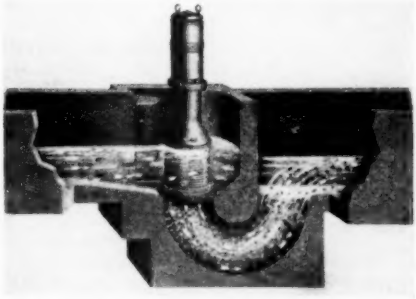

Cross section view of a typical channel design for the CHICAGO COMMINUTOR. Detailed drawings of acceptable channel forms are available to qualified engineers. For further information on COMMINUTORS, sizes, capacities and channel design write for Bulletin 185.

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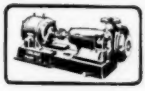

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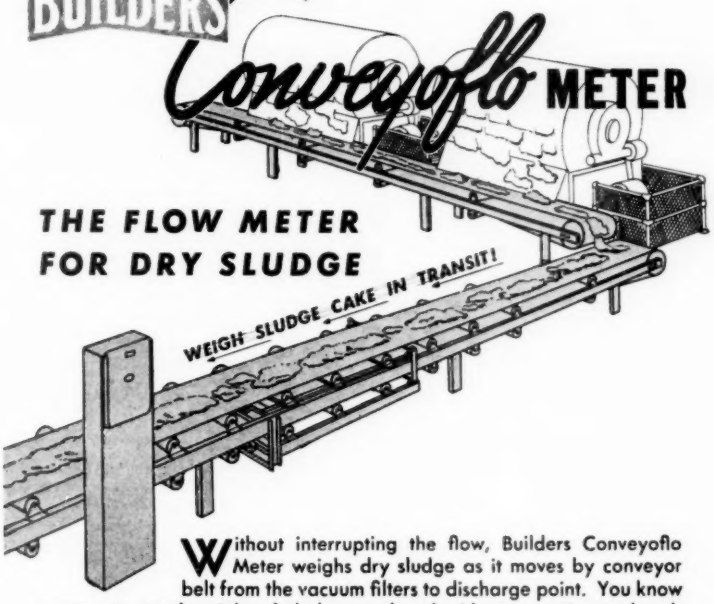

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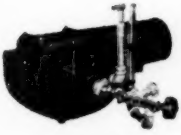

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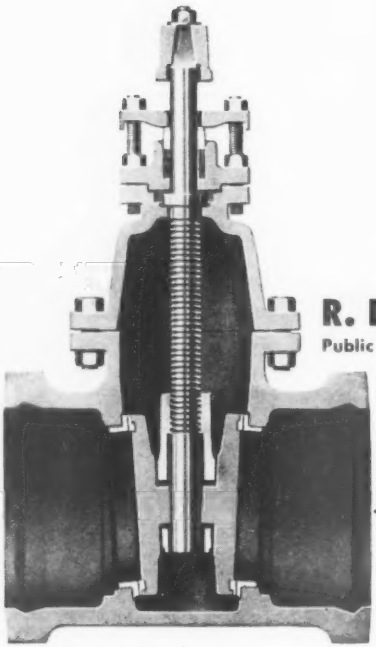

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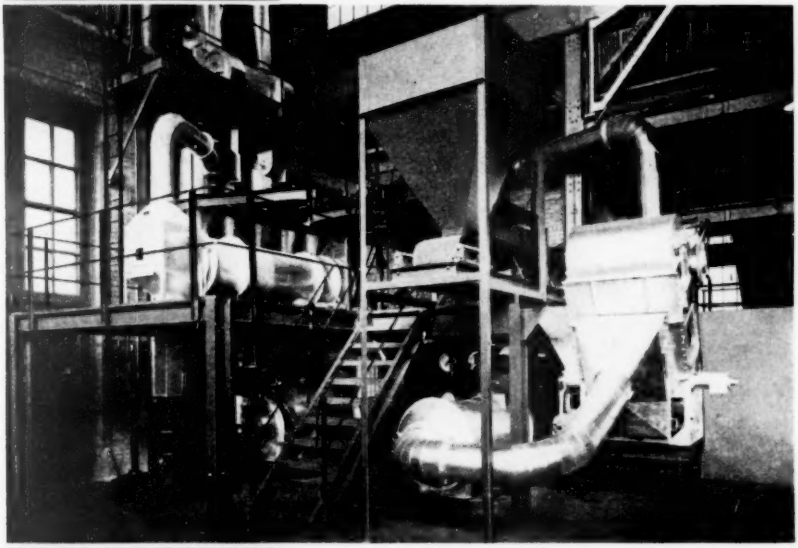

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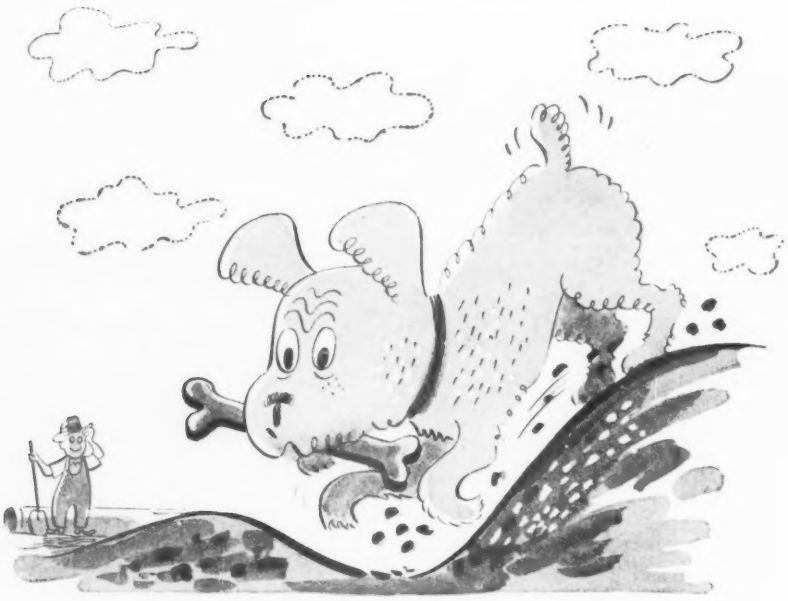

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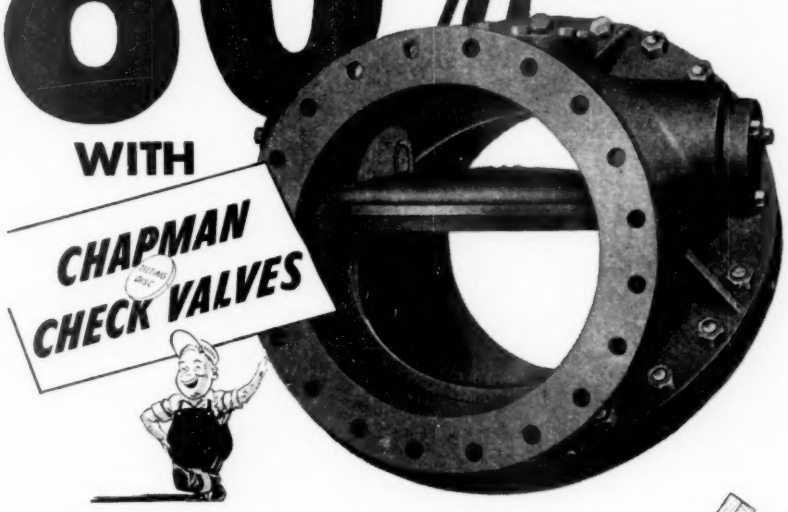

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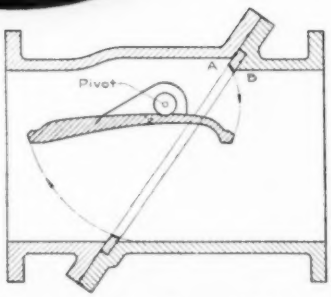
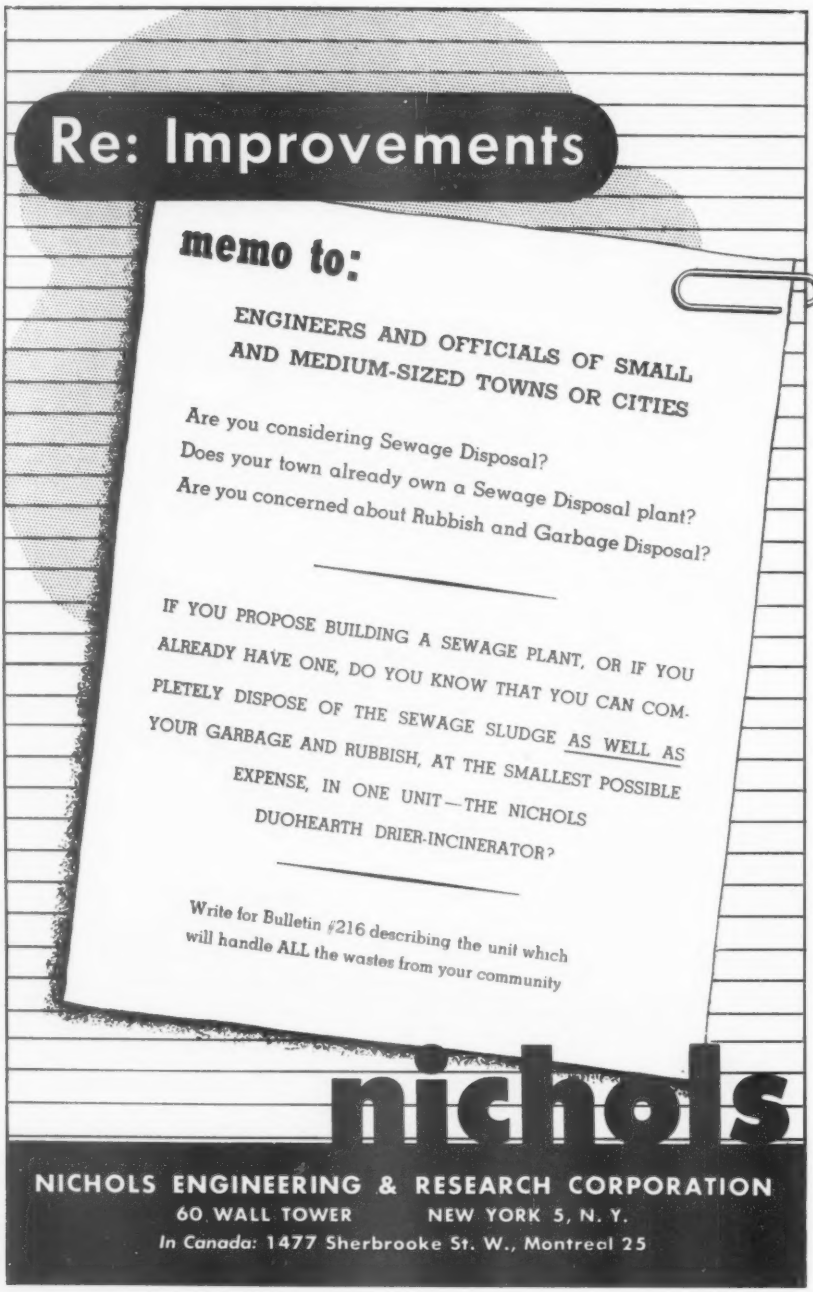
Chapman Tilting Disc Check Valves are available in either iron or steel. Send for bulletin containing engineering data and reports of tests.



Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

The Chapman Valve Mfg. Co.

INDIAN ORCHARD, MASS.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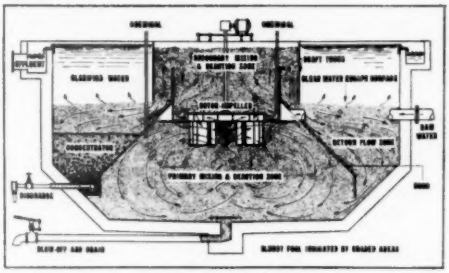
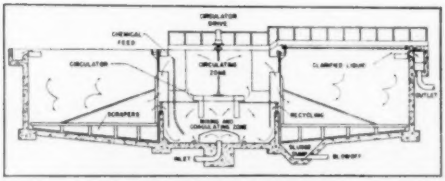


THE ACCELATOR



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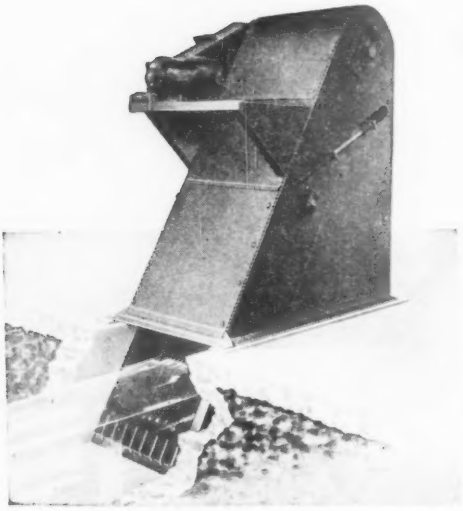

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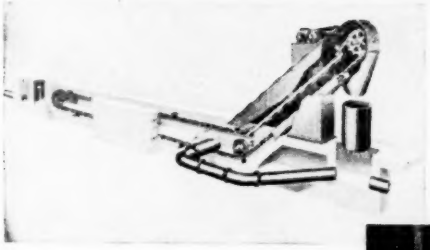

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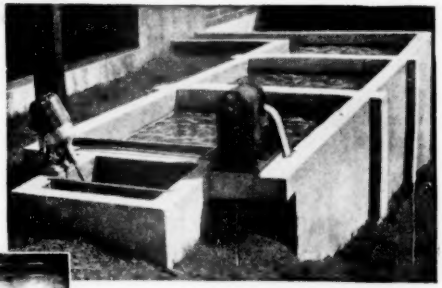

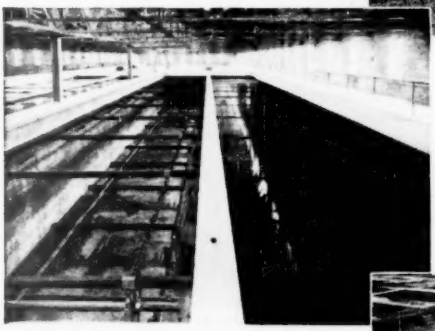

REX CONVEYOR SLUDGE COLLECTORS combine the well-known advantages of the rectangular settling tank with a rugged and efficient form of sludge removal mechanism. Whether handling primary sludge or light flocculent solids, their performance is trouble free and dependable. They rarely need to operate more than a few hours daily.

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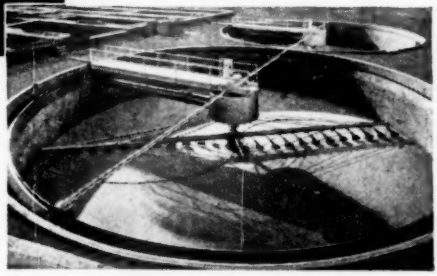

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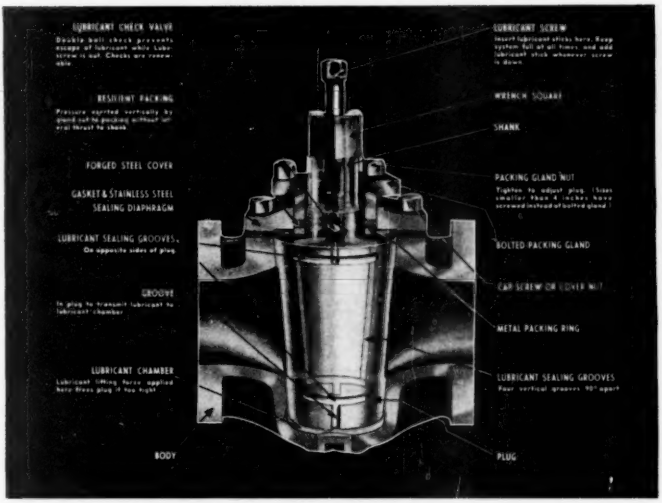

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Figure No. 58C

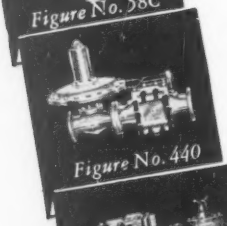
Figure No. 440

Figure No. 450

No matter what size plant, no matter how much variation in gas volume, there are VAREC Gas Control and Safety Devices that will permit the safe utilization of sewage gas and the automatic burning of waste gas in *your sewage treatment plant*. This sturdy, foolproof equipment is now specified in all sizes and types of sewage treatment plants.

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Fig. No. 236

S-6

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***Large Carrying Capacity* — permits intermittent operation.**

***Stable Conditions of Flow*—resulting from proper baffling of influent and correct location of effluent troughs.**

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***These Collectors* — for small, medium or large tanks—have been installed in many plants—all same general, well-proved design. Besides we make Bar Screens, Grit Washers and Collectors, Scum Removers, Chemical Feeders, Grinders, Sludge Elevators, Flocculation Equipment, etc.**

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Concrete pipe has the strength to sustain heavy overburdens. Its smooth interior finish resists abrasion and provides maximum hydraulic capacity.

When planning a storm drainage system—or a sanitary sewer—specify concrete pipe for ***low-annual-cost*** service.

Photos show installation of concrete catch basin and 84-in. concrete pipe on Calumet Expressway. The size of the concrete pipe in this project ranges from 12 in. to 96 in. in diameter.

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YEOMANS Spiraflo CLARIFIER with tangential inlet

Radically different from other types of clarifiers, Yeomans Spiraflo Clarifier is demonstrating in scores of installations its exceptional efficiency in BOD and solids removal—results directly attributable to these design features:

- Sewage enters the main clarification compartment at the bottom, after having spiraled through an annular race around the periphery of the tank
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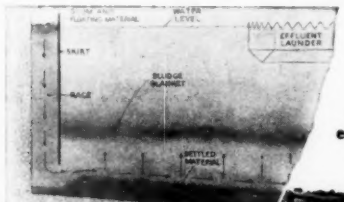
Spiraflo clarifiers can be installed in water treatment and in either trickling filter or activated sludge sewage treatment plants. A highly efficient overall plant reduction is achieved when the Spiraflo is used in conjunction with the "Aero-Filter" high capacity trickling filter system. Spiraflo clarifiers are the logical choice for primary treatment plants, especially those treating strong industrial wastes.

Bulletin 6790 contains full information with performance data and construction cost estimates—write us for it.



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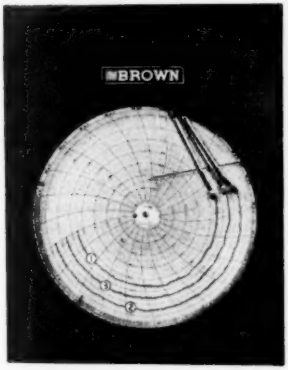
For Efficient Sludge Digestion

Record these 3 important temperatures



1 SLUDGE 2 HOT WATER—IN 3 HOT WATER—OUT

A continuous record of these three temperatures will provide a complete picture of digester operation . . . a constant check on efficiency.

You'll know if correct sludge temperature is being maintained for proper rate of digestion . . . and temperature differential between hot water to and from the digester will tell how well the heat is being absorbed by the sludge. The three readings, *centralized* on *one* chart, will provide an accurate guide to over-all efficiency and will warn of incrustation on the inner or outer surface of the heating coil.

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Exclusive AMERICAN development combines the best qualities of trickling filter and activated sludge into a unified, superior system.

Phantom view of typical Bio-Activation plant

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The most modern developments in sewage treating methods
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LOWER operating expense
SIMPLER laboratory control
GREATER ease of operation
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INCREASED stability and efficiency

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*Process Patented by American Well Works

LOW-COST CONVERSION OF EXISTING PLANTS CAN DOUBLE CAPACITY

Conversion of a straight trickling filter or activated sludge plant to *Bio-Activation* is easy and economical. Doubles the plant capacity, lowers operating cost, and requires less laboratory control.

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The AMERICAN *Bio-Activation** system utilizes the best qualities of trickling filters and the activated sludge process . . . combines and integrates them by an exclusive method so that they work together to achieve a superior result under all conditions. In *Bio-Activation*, the usual primary treatment is employed, followed by high capacity filters and short period intermediate sedimentation. Here, initial high removals of B.O.D. are obtained before the sewage is passed to aeration tanks where activated sludge is developed. Because of the intermediate filter treatment which considerably reduces the strength of the primary effluent, the liquor can be readily handled by the activated sludge process *without the usual upsets caused by exceptional conditions and shock loads.*

The advantages of this system assure a completely stable, final effluent which contains nitrates and is low in B.O.D. and suspended solids. Several alternative flow plans to meet various conditions are available.

Send for Bio-Activation Bulletin No. 259.

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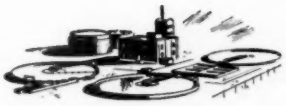
8. High in quality. Its constant uniformity can be depended upon.

Aluminum Sulfate is almost universally accepted by water experts as the best coagulant for removal of turbidity, color and bacteria from water . . . and General Chemical Aluminum Sulfate is the outstanding choice the nation over. That's because its high quality and constant uniformity have given it a time-tested reputation for reliability among operating men in towns and cities all over America.

Municipal officials in charge of sewage treatment also find that clarity of sewage effluent is easily obtainable with General Chemical Aluminum Sulfate for the many reasons outlined above. For your water and sewage disposal systems, specify General Chemical "Alum"—*preferred by most American cities.*



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2. Dry feeds well or dissolves readily for solution feeding.
3. Simple application. Requires only low cost feeding apparatus and minimum attention.
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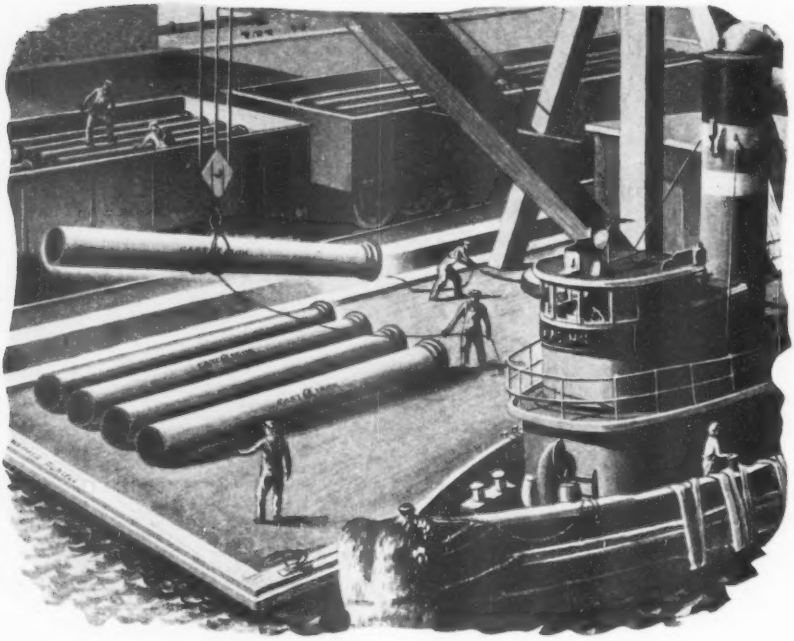

Cast iron pipe is on the move, in mounting volume, to cities and towns throughout America. For needed improvements and extensions to such vital public services as water and sewerage systems. Water works and sanitation engineers prefer cast iron pipe because of its record in the public service. For example, *96% of all cast iron water mains (sizes 6-inch and up) installed in 25 representative cities since 1817 are still in service.* This statement is based on a survey recently conducted by water works engineers. Cast Iron Pipe Research Association, T. F. Wolfe, Engineer, Peoples Gas Building, Chicago 3.

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SEWAGE WORKS JOURNAL

Official Bimonthly Publication — Federation of Sewage Works Associations

Volume XXI **MARCH, 1949** **Number 2**

Contents

Sewage Works

Sewage Disposal Program of the Allegheny County Sanitary Authority. By J. F. Laboon 197
Discussion by Ellis E. Bankson 213
Should Prevailing Sewer Rental Rates Be Adjusted? By A. H. Niles 215
Filter Paper Method for Suspended Solids Determination. By K. Fraschina 221
A Critical Review of the Literature of 1948 on Sewage and Waste Treatment and Stream Pollution. By FSWA Committee on Research 228

Industrial Wastes

Company Administration and Technical Organization for Industrial Waste Control. By R. R. Balmer 268
The Industrial Plant Waste Disposal Survey. By Roy F. Weston, Robert G. Merman, and Joseph G. DeMann 274
Experiments on Anaerobic Digestion of Wool Scouring Wastes. By M. T. Singleton 286
Compressed Yeast Wastes Treatment. III. Pilot Plant Digestion Studies. By Willem Rudolfs and Eugene H. Trubnick 294
Industrial Waste Control Policy of Westchester County, N. Y. By Thomas M. Riddick 306

Stream Pollution

Factors Influencing Self-Purification and Their Relation to Pollution Abatement. II. Sludge Deposits and Drought Probabilities. By C. J. Velz 309

The Operator's Corner

Watch Those Wet-Weather Flows! 320
Preventive Maintenance at Sewage Treatment Plants. By Robert Howell 321
Use of Internal Combustion Engines in Sewage Treatment Plants. By Roy A. Hundley 326
Elimination of Storm Water from Sanitary Sewers at Wadsworth, Ohio. By Frank G. Randall 332
Discussion by Homer Knox 333
Interesting Extracts from Operation Reports; Minneapolis-St. Paul; Detroit; San Diego 334
Sewage Quantities and Characteristics at Cranston, R. I. 344
Tips and Quips 352

Editorial

The First Step in Water-Borne Radiation Control 358

Proceedings of Member Associations

Central States Sewage Works Association 360
Virginia Industrial Wastes and Sewage Works Association 361
Iowa Sewage Works Association 362
Rocky Mountain Sewage Works Association 363
Michigan Sewage Works Association 364
Canadian Institute on Sewage and Sanitation 365
North Carolina Sewage Works Association 366
Member Association 1949 Meetings 367

Reviews and Abstracts 368

Book Review 377

1949 Federation Directory

Officers, Awards, Meetings, and Committees 379
Consolidated Membership List 396

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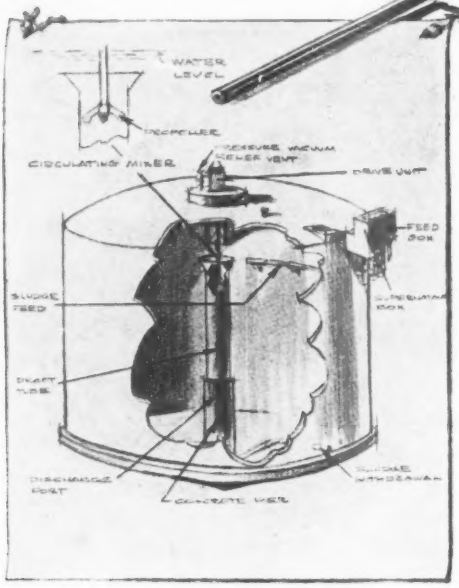
What does intensive mixing mean in Digester operation?

Here's what Mr. Norman Wagner, Superintendent of the Stamford, Conn. Sewage Treatment Plant reports . . .

TESTS WERE RECENTLY CONDUCTED at the Stamford, Conn., Sewage Treatment Plant to measure the effect of intensive mixing on scum formation in Dorr Digesters. A 50' dia. Primary Dorr Digester with a fixed steel dome was equipped with a draft tube and high-capacity circulating mixer arranged so that conditions within the tank could be observed. As typified by Mr. Wagner's comment, results were definite and conclusive:

"During testing of Dorr Digester equipped with a high-capacity circulating mixer, we allowed scum to build up for a period of one week. The result was a scum layer a foot thick ...which disappeared after only 60 minutes of mixing."



✓ *Scum formation was positively eliminated. All scum was submerged by mixing action.*

✓ *Action was rapid . . . 60 minutes to eliminate 1 foot scum layer . . . an hour and a half to turn over entire tank contents.*

✓ *Continuous operation of the mixer was not required.*

✓ *Intermittent operation of the mixer maintained a homogenous sludge mixture.*

The draft tube and circulating mixer demonstrated at Stamford are now standard on Dorr Type M and MA Digesters. Several installations featuring this new development are now being made . . . one of which comprises 18 110' dia. units, each equipped with 3 mixers. A Dorr engineer will gladly furnish more detailed information on this new and proven development.

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Sewage Works

SEWAGE DISPOSAL PROGRAM OF THE ALLEGHENY COUNTY SANITARY AUTHORITY *

By J. F. Laboon

Chairman of the Board and Chief Engineer, Allegheny County Sanitary Authority, Pittsburgh, Pa.

Pittsburgh, as the center of 102 participating municipalities, has finally taken definite action toward stream pollution abatement, thus to separate itself from the few remaining metropolitan centers which are not treating their sewage.

In 1943 a special committee comprising Major General Thomas M. Robins, Ralph E. Tarbett and Dr. Abel Wolman made a study of pollution of the Ohio River for the Acting Secretary of War, and reported as follows on conditions in the Pittsburgh area:

"The organic waste load reaching the Ohio River from Pittsburgh and its suburbs has a population equivalent of 1,334,300 of which 597,200 discharge to the Allegheny, 458,500 discharge to the Monongahela and 278,600 discharge to the Ohio River direct. When the residual organic waste load from population equivalents of 917,200 in the upper Allegheny River and 796,200 in the upper Monongahela River is added to that from Pittsburgh and its suburbs, it becomes apparent that the concentration of organic waste below Pittsburgh is larger than that below any other community on the Ohio River proper. Additional pollution of significance includes 1,032,000 tons per year of acid waste (calcium carbonate equivalent) which flows from the area adjacent to and above Pittsburgh.

"The normal bacterial effect of untreated human wastes apparently is masked by acid pollution of the upper Ohio River. However, coliform bacteria counts at Emsworth Dam, six river miles below Pittsburgh, varied from less than one to as high as 811 per milliliter in 39 samples collected from September 1940 to March 1941. The median count was 52 and the average 94 per milliliter. Ten per cent of the samples had coliform bacteria counts in excess of 200 per milliliter. Water of this quality is unsuitable for domestic water supply and definitely dangerous for bathing purposes.

"Partial oxygen depletion, denoting unsatisfactory sanitary conditions, was noted below Pittsburgh in October 1940. On the days of maximum oxygen depletion flows average four times as large as the minimum flows of record."

In the upper Ohio River basin, which includes the Pittsburgh area, the report stated that:

"Free acid in waste pickle liquor discharged by metallurgical industries adds about 2.5 per cent to the mine acid load."

The measurable annual damage from corrosion and injury to water supplies due to acid mine drainage as of 1940 to users of the Ohio River and its tributaries above the Ohio-West Virginia-Pennsylvania state line was over $2,000,000, and the intangible damages are probably equal to the tangible damages, according to the above report. It was also estimated that it would cost approximately $3,060,000 to complete the mine-sealing program in the Allegheny and Monongahela River basins in accordance with the 1940 re-

* Presented at the Twentieth Annual Conference, Pennsylvania Sewage and Industrial Wastes Assn., State College, August 25–27, 1948.

strictions, and that the annual cost of maintaining the completed works would be less than $\frac{1}{5}$ of 1 cent per ton of coal produced.

In the Authority service area of Allegheny County, including the cities of New Kensington and Arnold in Westmoreland County, of the 31 water supply sources serving the various communities, 15 take their water supply wholly or partly from surface streams, 14 take their water supply from wells drilled in the vicinity of surface streams and five take their supply wholly or partly from cribs located in the bottom of the river. However, the water distribution agencies using these sources of supply totaled 51 in 1945.

Nature of Municipal Authorities Under the Pennsylvania Act

The earlier Pennsylvania laws governing the establishment of municipal authorities were supplanted by the recodified Municipality Authorities Act of 1945, under which the Allegheny County Sanitary Authority was created.

This Act makes Authorities public corporations having a life of 50 years, and gives them broad and independent powers to acquire, construct and operate projects of many kinds, including sewers and sewage treatment works. Authorities are empowered to borrow money and to issue bonds, but not to pledge the credit or taxing power of the State or of any municipality, the only security for their bonds or other obligations being the revenue secured from the operation of their project.

Rates and charges for the use of an Authority's facilities are fixed exclusively by the Authority board, and the Public Utility Commission has no authority to interfere. Such rates and charges, however, must be reasonable and uniform, and are subject to the jurisdiction of the Common Pleas Court upon appeal by any person questioning their reasonableness or uniformity.

Authorities possess many of the advantages and powers of municipalities, and are subject to similar restrictions. Authority property is not taxable, and Authority bonds are tax-free. Authorities have the power of eminent domain, but they may not operate any project in competition with an existing private enterprise. All contracts for labor or materials in excess of $500 must be advertised and awarded to the lowest competent bidder. The Attorney General of the Commonwealth has the right to examine the books, accounts and records of the Authority.

The Authority under a 1947 Amendment may construct lateral sewers and charge their cost to property owners on a front foot basis, upon agreement with any municipality.

Outline of Studies

The engineering activities of the Authority for the purposes of the "report phase" of its initial operations may be summed up as follows:

(1) Measurement of the flow from the major sewers of Allegheny County.

(2) Collection and analysis of samples of sewage and industrial wastes from the measured sewer outlets.

(3) Studies of the quantity and character of the industrial wastes of the 30 industries which are participating in the Authority program.

(4) A study of each of the 51 water agencies supplying water to the 97 municipalities and to the State and County institutions in Allegheny County and to New Kensington and Arnold in Westmoreland County, to determine the actual quantities of water sold as classified under domestic, commercial and industrial usage. These data were used also in the design of a rate schedule for sewage service charges.

(5) Collection and study of the plans

of sewerage systems of 101 municipalities.

(6) The determination of the leakage or infiltration into the sewer systems of the various municipalities.

(7) A study of the sanitary character of the main streams of Allegheny County.

(8) Studies of the quantities of storm water which the intercepting sewer system would be designed to carry in addition to sewage and industrial wastes.

(9) Preparation of preliminary designs to determine sizes and grades of intercepting sewers.

(10) Determination of degree of treatment required at each of the sewage treatment plants considered under the various projects.

(11) Survey and study of sites and location of sewage treatment plants and sewage pumping stations under the various projects.

(12) Preparation of preliminary designs of sewage treatment plants and sewage pumping stations.

(13) Preparation of estimates of cost of the various projects.

(14) Preparation of operating costs and annual burden of the various projects.

(15) Study of the feasible plans for financing the Authority program.

(16) Preparation and study of rate schedules for sewage service charges.

Geography

Allegheny County as of January, 1948, is divided into 129 municipal subdivisions consisting of one second class city, three third class cities, 74 boroughs, 22 first class townships and 29 second class townships. The County comprises an area of 745 sq. mi., of which 420.5 sq. mi. are represented by the 101 participating municipalities, including the areas of the cities of New Kensington and Arnold in Westmoreland County.

The Allegheny River above the Point has its source in Pennsylvania and New York and has a total drainage area of 11,733 sq. mi., with a minimum dry weather flow in 1930 of 550 c.f.s. The maximum flow in the flood of 1936 was 365,000 c.f.s.

The Monongahela River, with its source in West Virginia, has a total drainage area including the Youghiogheny of 7,384 square miles. The minimum dry weather flow in 1930 was 150 c.f.s. and the maximum in 1936 was 201,000 c.f.s.

The Ohio River above Sewickley Creek on the west border of Allegheny County has a total drainage area of 19,500 sq. mi., with a minimum flow of 815 c.f.s. and a maximum flow in 1936 of 574,000 c.f.s.

Industries of the County consist principally of those related to steel and coal. The great deposits of coal are the source of acid mine wastes which, according to the 1943 Report of the U. S. Public Health Service on Ohio River Pollution Control amounted to more than 7,000,000 lb. daily (as calcium carbonate) for the Allegheny and Monongahela River drainage basins before mine-sealing operations were started. The mine-sealing operations removed a little more than 1,600,000 lb. of acid daily. The same report states that it is economical to remove by sealing an additional 2,000,000 lb. daily. The masking effect of these acid wastes on organic pollution has served up to now to inhibit putrefaction and to prevent what could be the most odoriferous metropolitan center in the United States. The free acid load from pickle liquor (as calcium carbonate), according to the 1943 Report, amounted to approximately 170,000 lb. daily in the Allegheny and Monongahela River drainage basins.

Population

Population studies went back as far as 1790 and took into consideration the data made available by the U. S. Bureau of Census and other governmental and local agencies. The actual

TABLE I.—Summary of Design Quantities, Year 2000

Basin	Domestic (m.g.d.)	Commercial (m.g.d.)	Industrial (m.g.d.)	Total from Water Supply (m.g.d.)	Infiltration (m.g.d.)	Grand Total (m.g.d.)	Design Population, Year 2000	Per Capita Flow (gal. / day)
Monongahela	30.877	17.860	12.151	60.888	30.640	91.528	837,300	111
Allegheny	29.221	21.231	19.699	70.151	25.644	95.795	687,000	139
Ohio	18.563	7.183	8.254	34.000	24.491	58.491	522,400	112
Totals	78.661	46.274	40.104	165.039	80.755	245.814[1]	2,046,700	121

[1] Assumed as 250 m.g.d. for ultimate design.

population of the County was forecast to the year 2000, resulting in an ultimate population of 1,820,000. For design purposes, however, the population for the year 2000 was assumed to be 2,000,000.

The population in this metropolitan area, as well as elsewhere in the United States, has been declining steadily in terms of persons per family. In 1910, the persons per dwelling unit were 5.03, in contrast to 3.77 as of 1947.

Quantities of Sewage

A representative group of 35 locations was selected for installation of weirs, which total a presently-served population of 678,000 and a dry weather sewage flow of 64,400,000 gal. daily. These weirs represented 26 drainage districts out of a total of 59. The weirings gave a weighted average of dry weather flow of 95 g.c.d. This was increased to 102 g.c.d. with the inclusion of presently acceptable and anticipated industrial wastes as of the year 1965, the initial design provisions for sewage treatment. Increased industrial and commercial development and greater domestic usage of water for garbage grinding units and other household developments increased the estimated daily flow for the year 2000 to 121 gal. per capita. Table I gives a breakdown of these quantities for the year 2000.

Infiltration was determined accurately by a comparison of water usage and sewage flow in both dry weather and wet weather. Measured infiltration average 18,600 gal. per mile of sewer per day. For purposes of interceptor capacity determinations a value of 25,000 gal. per mile per day was assumed for the entire service area (Table II).

TABLE II.—Analysis of 24-Hour Composite Samples Computed from Data Collected at 32 Sewers

Average flow (m.g.d.)	60.361
Days sampled	6.27
pH	7.4
Alkalinity as $CaCO_3$ (p.p.m.):	
Total	140
Phenolphthalein	2.8
Chlorides as Cl (p.p.m.)	69
Suspended solids (p.p.m.):	
Total	236
Volatile	175
Fixed	61
Per cent volatile	74.2
5-Day B.O.D. (p.p.m.)	226
Nitrogen as N (p.p.m.):	
Total	26.2
Organic (by difference)	13.0
NH_3	13.2
Grease (p.p.m.)	49

The total population served by sewers in Allegheny County was 1,342,000 in 1945.

Character of Sewage

Sewage was collected from each of the weiring points at intervals of 15 min. throughout the 24 hours of the day for a period of 7 days or longer. Weighted composites were made up on a basis of three 8-hour periods of the day, as well as for a 24-hour day, thus permitting check determinations. A complete sanitary analysis

was made of each sample including grease and iron determinations. All samples were analyzed in duplicate.

A calculated composite was prepared using the analytical results of the samples obtained from weiring points and adding thereto the known industrial wastes of the 30 large industries which were investigated and reported on by the Authority, as well as the assumed values of all other wastes known to be located in the respective drainage districts. The results of the calculated composite produced a weighed value of 259 p.p.m. of suspended solids and 287 p.p.m. of biochemical oxygen demand. For the purposes of the report these results were rounded out to 275 p.p.m. of suspended solids and 300 p.p.m. of B.O.D. Table II summarizes the results of the composite analysis.

Industrial Wastes

As a matter of policy the Authority has adopted the plan of accepting for collection and treatment all industrial wastes which are found to be of a nature which will not affect adversely the structures nor the proposed treatment processes. It is obvious that the greater the amount of domestic sewage available for dilution purposes the greater the quantities of industrial wastes that can be accepted and neutralized as a result. Therefore, the larger the sewage treatment plant capacity the greater the quantities of industrial wastes that can be accepted for treatment. A detailed study of the sale of water by the 51 water service agencies of Allegheny County developed that the commercial and industrial usage of water amounted to approximately 60 per cent of the total water sales and, therefore, commercial and industrial sewage quantities become quite important from the standpoint of facilities which must be provided by the Authority for their collection and treatment.

From the beginning it was quite obvious that not all industrial wastes could be accepted for treatment. The large quantities of acid iron wastes, mineral oils, acids and inhibitive materials such as copper, nickel, vanadium, chromium and cyanide required a careful determination of not only acceptable quantities but also the establishment of definite policies with regard to their rejection.

It was finally concluded that acid-iron wastes would be prohibited to avoid discrimination because of the large quantities involved and the limited quantities which could be accepted for treatment with secondary biological treatment processes. Under the Pure Streams Act only those industries as discharged their wastes directly into the streams of the Commonwealth are subject to the Act and the orders of the State Sanitary Water Board. All industries which maintain connections with municipal sewer systems become the responsibility of the respective municipality. The latter can legislate by ordinance for control of such industrial wastes. Under this Act, the State issued orders to more than 90 industrial plants in the Pittsburgh area, many of which were cases involving the discharge of sanitary sewage into the streams, and therefore, could be solved simply by connection with the nearest municipal sewer. Others, however, had much more difficult problems involving both sewage and industrial wastes. The Sanitary Authority contracted with 30 industries falling in the latter category to determine the quantity and character of industrial wastes and the cost of treatment should such wastes be found acceptable for collection and treatment in the Authority facilities. Matters of engineering concern were left to the consulting engineers.

As the result of its comprehensive study of industrial wastes, the Authority has provided in its estimates for the collection and treatment of 30 m.g.d. of industrial wastes in the

year 1965 and 40 m.g.d. in the year 2000.

Industrial wastes possessing characteristics which impose loads greater than the average organic pollution or sludge quantities expected at the sewage treatment works impose additional costs for treatment and sometimes for collection services and, therefore, many municipalities have adopted the policy of making an extra charge for handling industrial wastes as measured by the extra cost of treatment and disposal. Usually a measure of this cost is determined by the excessive B.O.D., suspended solids, the pH and the chlorine demand of the particular industrial waste. The Sanitary Authority has decided to make a charge for excessive concentrations of industrial wastes accordingly.

The adopted limits of concentration for toxic and deleterious wastes in the composite sewage as it enters the plant for treatment are given in Table III.

Ground Garbage Wastes

The study of this problem revealed that more than 600 home grinding units for garbage disposal have already been installed through the metropolitan area and that an anticipated 1,000 additional units will be installed during 1948.

Garbage is being successfully disposed of in conjunction with sewage in municipal sewage treatment plants and, therefore, it has been concluded that even though the installation of home garbage grinding units may proceed in great numbers over future years, the only problem facing the designers is the provision of sufficient capacities in the collecting system for the additional quantities of water accompanying the ground garbage and the additional construction necessary for enlarged sludge treatment and disposal facilities.

River Surveys

River surveys were conducted in the low water periods of 1946 and

TABLE III.—Concentration Limits for Toxic and Deleterious Wastes In Composite Sewage Of Treatment Plant Influent [1]

Substance or Property	Primary Treatment		Secondary Treatment	
	No Sludge Digestion	Sludge Digestion	Single Plant	Several Plants
pH Index	5.0	6.5	6.5	6.5
Total iron (p.p.m.)	5.0	5.0	5.0	5.0
Copper (p.p.m.)	3.0	1.0	1.0	1.0
Chromium (p.p.m.)	5.0	5.0	3.0	3.0
Cyanide (p.p.m.)	2.0	2.0	2.0	2.0
Oils—mineral	Should be excluded by municipal ordinances.			
Oils—soluble	Removed to maximum practicable extent before discharge.			
Combustibles, etc.	Should be excluded by municipal ordinances.			
Free mineral acids	Should be neutralized at source.			
Acetylene generation sludge	Should be excluded by municipal ordinances.			

[1] These limits are based on their effect on treatment and on the stream receiving the effluent.

1947 with a view to determining the ability of the large streams in the metropolitan area to dispose of sewage and industrial wastes by dilution; also to determine the re-oxygenating properties of the streams and, finally, to determine what degree of treatment was necessary to maintain a proper oxygen balance in the streams resulting from the discharge of large quantities of treated sewage at one or more points. In 1947 additional surveys of the streams were made to determine the general prevalence and nature of sludge beds on the bottom of the streams.

Aside from the great use being made of the streams in this area for navigation purposes, the most important use of these streams is as a source of water supply for this great metropolitan area. It is not an exaggeration to state that the streams in the Pittsburgh district are being used as open sewers for the discharge of municipal sewage, industrial wastes and acid mine drainage, from which the water supplies generally are taken.

The most important water supplies in the Pittsburgh area are taken from these streams. The city of Pittsburgh takes its water supply from the Allegheny River at Aspinwall. Notrona, Brackenridge, Tarentum and surrounding communities do likewise, except that they are located farther upstream. New Kensington, Arnold, Oakmont and Wilkinsburg are also in the same category. The boroughs of the South Hills and a portion of the city of Pittsburgh, with some others, are served by the South Pittsburgh Water Company, which takes its supply from the seriously polluted Monongahela—also a source of water supply for Braddock, McKeesport, Glassport and other upriver communities.

Some of the municipalities upstream and downstream take their supplies from wells and cribs located in the rivers and are not completely free from danger of pollution. On the Ohio below the Pennsylvania state line, practically all the large communities take their supply of water from the river.

Industries also use the streams as a source of water supply and are required to spend large sums of money for treatment to produce satisfactory water for their operations.

A study was made of the Ohio, Allegheny, Monongahela and Youghiogheny Rivers to determine the effect of existing pollution on the oxygen content of the streams as they traverse the County. One set of 186 samples was taken in 1946 and another of 347 samples in 1947 during low water periods. Samples of river water were collected and analyzed for acid and/or alkalinity, pH, temperature, iron, manganese and organic pollution as measured by B.O.D. Complete chemical and sanitary analyses were performed on 129 of the samples taken in 1946.

Sludge samples were collected from the beds of the Ohio, Allegheny and Monongahela Rivers in 1947 and analyzed for volatile matter and iron.

Figure 1 shows the results of the dissolved oxygen tests on the three main streams in per cent of saturation. The river flows in c.f.s. during the period of testing were as follows:

Year	Allegheny River	Monongahela River	Ohio River
1946	1470–2050	703–1130	2450–3450
1947	1540–2860	1250–2700	3240–6170

Volatile matter in the sludge samples from the three main streams ranged from 11 to 25 per cent. Iron ranged from 3 to 15 per cent.

Degree of Treatment Required

Orders of the State Sanitary Water Board to the various municipalities in the Authority service area were varied in regard to the degree of treat-

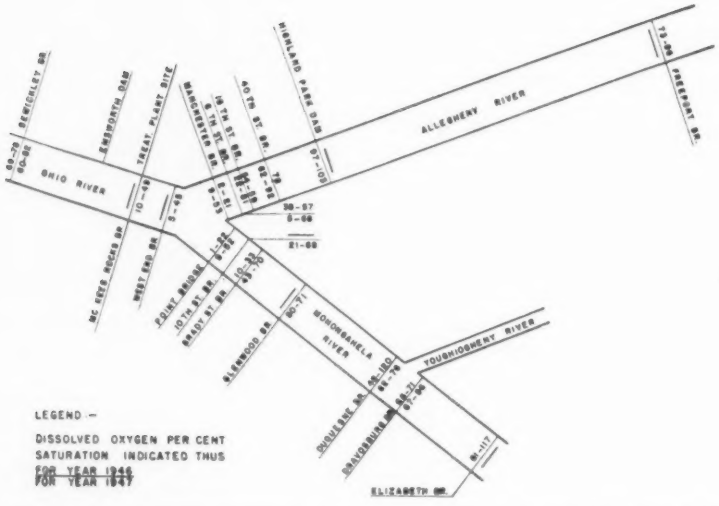

FIGURE 1.—Oxygen saturation in streams in Pittsburgh area, 1946 and 1947.

ment required, this being dependent upon the local condition of the streams. But in general, for the communities in this area located on the large rivers, the orders require primary treatment of the sewage discharging from the sewer systems, and specifically the following:

"Primary treatment shall be construed to be such as in the opinion of the Sanitary Water Board will remove practically all of the settleable solids; will remove at least 35% of the organic pollution as measured by the biochemical oxygen demand test; will provide effective disinfection where necessary to control disease producing germs; will provide satisfactory disposal of sludge; and will produce an effluent that is suitable for discharge into the receiving stream."

The Ohio River Committee appointed by the Secretaries of War and of the Treasury, reporting in 1943 on Ohio River pollution control, made the following statement:

"Primary treatment and chlorination would be adequate for all municipal sewage from the Pittsburgh area. All or most of the wastes entering the streams in this region could be most economically treated at a large plant on the Ohio River."

The 1943 Report of the United States Public Health Service on Ohio River Pollution Control arrived at the following conclusion with respect to degree of treatment required:

"It is not necessary, nor would it be economically justified, to provide complete treatment for all sewage. The capacity of streams to purify themselves is a valuable and usable asset. The necessary degree of treatment depends on the self-purification capacity of the stream or streams involved and the necessary standard of water quality to avoid undue interference with normal water uses."

Studies were made of the degree of treatment required for the various projects involving one or more treatment plants, and the approximate degree of treatment was established for the individual plants under the various projects according to the circumstances.

The Authority engineers and the consulting engineers, after giving

proper study to the technical findings and to annual costs of debt service and operation, have concluded that a central plant located on the Ohio River is in their judgment the best plan, and that primary treatment and preaeration with chlorination during critical low water periods is sufficient for the present. However, in order to accomplish a satisfactory condition in the Ohio River in the mixture of the river water with the treatment plant effluent so that the mixture shall contain sufficient oxygen to prevent nuisance, it is proposed to operate continuously the preaeration treatment preceding the sedimentation tanks so as to produce at least a 40 per cent reduction of the organic pollution as measured by B. O. D.

An additional reduction of organic pollution will be secured by the application of chlorine during periods of critically low flow in the river. The combination of preaeration, sedimentation and chlorination may safely be assumed to provide a total reduction of not less than 50 per cent of the organic pollution in the raw sewage.

A 50 per cent removal would reduce the B.O.D. to a value of approximately 150 p.p.m., and for proper dilution with the river waters of the Ohio, the required river flow is a minimum of 3,500 c.f.s. According to the U. S. Engineer Office river records, such dilution is available in the Ohio at the point of proposed effluent discharge 98 per cent of the total time with present low water regulation by the flood control dams.

Proper consideration was given to the possibilities of "Low Flow Regulation" and its effect on the requirements of degree of treatment not only on the basis of existing installations but also of the projected installations. The findings are well expressed in the 1943 report of the U. S. Public Health Service on Ohio River Pollution Control, as follows:

"Untreated municipal sewage may cause nuisance conditions even though the flow of the receiving stream is quite large, because of floating solids, scum, grease, and the settling and subsequent decomposition of part of the suspended matter with accompanying odors. Hence, low-flow regulation is not a substitute for sewage treatment but an effective supplement which can be used to eliminate the need for more than primary treatment and to improve stream quality where satisfactory complete treatment methods are not available at present."

Even though all organic pollution and all industrial wastes were to be removed from the streams by treatment, however, fish and other aqueous life will not return and the use of the streams for recreation will not be possible in an appreciable degree unless acid mine discharge is materially reduced.

The Ohio River Committee appointed by the Secretaries of War and the Treasury, reporting on Ohio River pollution control in 1943, said:

"Up to the present time, uncorrected mine acid pollution has served as a deterrent to organic pollution abatement activities. It is desirable that mine acid control and organic pollution abatement be carried on as parallel programs since both measures are necessary if reasonable restoration of stream quality is to be obtained. A combined program of mine sealing and low flow regulation seems to offer the best solution to the mine acid problem."

Intercepting Sewer System

Studies involved 98 miles of main intercepting sewer system and 150 miles of branch intercepting sewers. Of the total of over 248 miles of ultimate development of intercepting sewers, 156 miles have been included in the estimates for immediate construction.

The difficulty of finding a satisfactory and not too costly design for the intercepting sewer system is quite obvious from a casual survey of the narrow streets fronting the industrial

plants located along the streams and the built-up banks of the river through most of the entire length of the three main streams in Allegheny County. Studies finally developed a subaqueous design for location of the larger part of the main interceptor system in the beds of the rivers, to the largest extent ever attempted. About 52.5 miles of the main intercepting sewer are proposed for subaqueous construction and 21 miles as force main. The subaqueous construction was found to be $8,000,000 less costly than the land construction design consisting of tunnel and open-cut construction. The recommended project includes 12 inverted siphons, 10 of which are on combination outfall sewer connections and river crossings to the main interceptor.

Interceptor capacities are predicated on a rational development of storm flow interception plus the maximum sewage flow determined for the highest quarter of the year of water usage plus infiltration. A thesis was developed, predicated on the interception of 250 per cent of average flow, and with provision of such control as would cut back the peak storm flow, when it reaches 250 per cent, to a predetermined maximum hourly dry weather rate of flow, then continuing at such rate until the flow has returned to normal.

A sewage hydrograph was prepared for each day of the average week for the inflow to the central treatment plant as of the year 1965, and it indicated a peak of 125 per cent of the average flow for the average week (Figure 2).

Storm water hydrographs for the inflow to the central sewage treatment plant produced a peak of 154 per cent of the average dry weather flow involving 12 hours of elapsed time between the farthest interception and the sewage treatment plant (Figure 3).

It is proposed to provide electrically operated gates with remote control located at the sewage treatment plant for regulation of the largest and most important outfalls during storm flows.

The storm flow interception thesis indicates that no more than 1.5 per cent of the total annual sewage flow will be discharged untreated into the rivers as a result of overflow.

Design Considerations for Sewage Treatment Plant

Studies of the types and number of sewage treatment plants have been

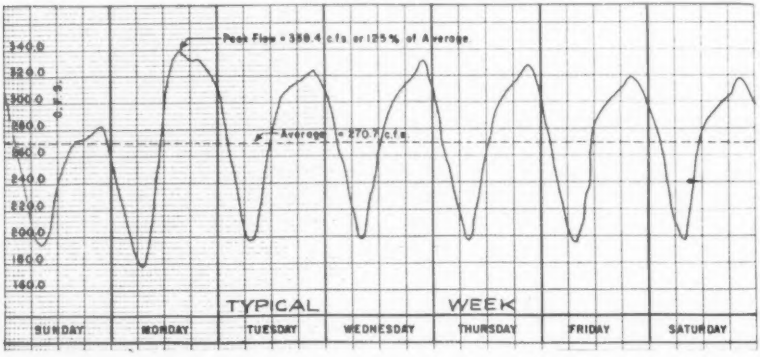

FIGURE 2.—Hydrograph of total sewage flow to plant, 1965 conditions.

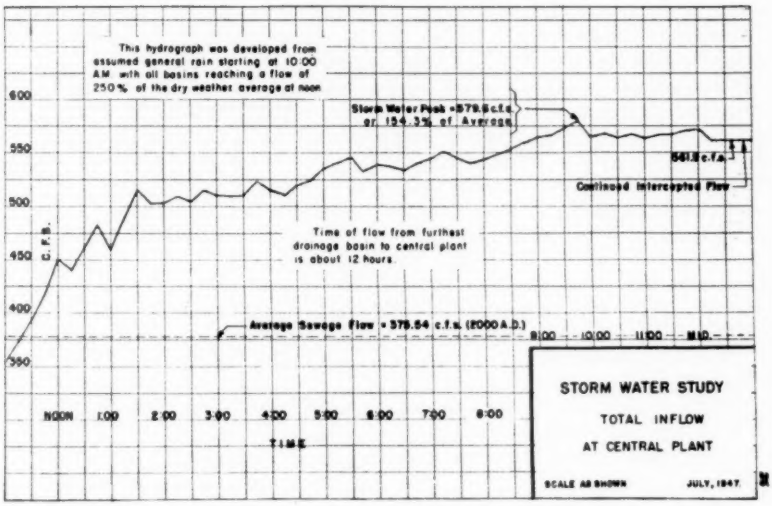
This hydrograph was developed from assumed general rain starting at 10:00 A.M. with all basins reaching a flow of 250% of the dry weather average at noon
Storm Water Peak = 579.6 c.f.s. or 154.3% of Average
561.5 c.f.s.
Continued Intercepted Flow
Time of flow from furthest drainage basin to central plant is about 12 hours.
Average Sewage Flow = 375.64 c.f.s. (FOOD A.D.)
c.f.s.
600
550
500
450
400
350
NOON 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00
TIME
8:00 10:00 11:00 MID.
STORM WATER STUDY
TOTAL INFLOW
AT CENTRAL PLANT
SCALE AS SHOWN
JULY, 1947

FIGURE 3.—Storm water hydrograph; Allegheny County Sanitary Authority.

predicated on the following considerations:

(1) The Sanitary Water Board's requirements.
(2) Odorless operation.
(3) Effect on stream of plant effluent discharge.
(4) Economy of construction and operation.
(5) Available sites.

The capacities of the sewage treatment plants to accord with the requirements of the individual plants under the four projects were given full consideration with respect to economic and other advantages. Partial or conplete treatment was provided under the various projects as required by the conditions of the stream into which the effluent is to be discharged.

The average flow for 1965 was calculated to be 175 m.g.d., and for the year 2000, 250 m.g.d.

Primary treatment provided whereever required consisted of a design which included a main pumping station, coarse screens, grit chambers, fine screens, comminutors, grit storage and incineration, preaeration, primary settling, skimming, chlorination, sludge digestion, elutriation, dewatering, sludge incineration, ash disposal and power generation from sludge gas. This type of plant will produce an effluent which will meet the required standards of the Sanitary Water Board and permit of discharge into low flows of the Ohio River without resultant nuisance.

A special study was made at the Ashland, Ohio, sewage treatment plant to develop the advantages and possibilities of incineration of wet sludge, thus eliminating sludge digestion, gas collection, power generation, elutriation and dewatering. The Ashland tests were satisfactory and gave increased hope for future development of this idea in a large plant, but until furnace equipment manufacturers develop incinerators which they consider satisfactory for such services, it was concluded that sludge digestion, gas collection, power generation, elutriation and dewatering be included

in the proposed plant design for the present.

Economic studies were made of sludge disposal and power generation for the central treatment plant and for those individual treatment plants under the various projects as were sufficiently large to be affected by such economic factors. Studies indicated that complete digestion with sludge gas collection and power generation by means of dual fuel engines produced an over-all saving as compared with the purchase of power and heat requirements.

The site selected for the central treatment plant is sufficiently large to permit of extensions and the development of secondary treatment for the ultimate requirements of the year 2000. Figures 4 and 5 show a plan of the proposed sewage treatment plant and the flow diagram, respectively, for the central plant project.

Sludge Fertilizer

The Authority engineers are recommending the construction of a sewage treatment plant which would include complete digestion and incineration of sludge, but would provide means whereby the dewatered sludge filter cake may be made conveniently removable for use as a humus fertilizer by those who desire to take it. Should this sludge filter cake become highly popular, some revenue may be obtained from its sale at a nominal price, but it has been concluded that special processing of sludge fertilizer to compete with "Milorganite" is unprofitable and inadvisable.

Manufacture and sale of prepared fertilizer produced from sewage sludge may be said to be considered more of an attempt to reduce the over-all cost of sludge disposal rather than a profitable enterprise.

Outline of Alternate Projects

Complete studies were made of four projects involving one, three, five and eleven sewage treatment plants, with corresponding design and location of sewage pumping and sewage lift stations.

Project No. 1

Comprises a single central sewage treatment plant serving the entire Authority service area (Figure 6) with the exception of a small sewage treatment plant which is to be built at Buena Vista on the upper Youghio-

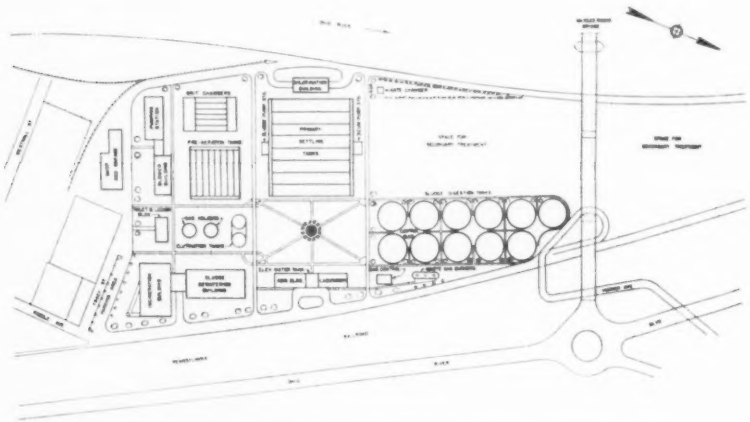

FIGURE 4.—Layout of proposed central sewage treatment plant.

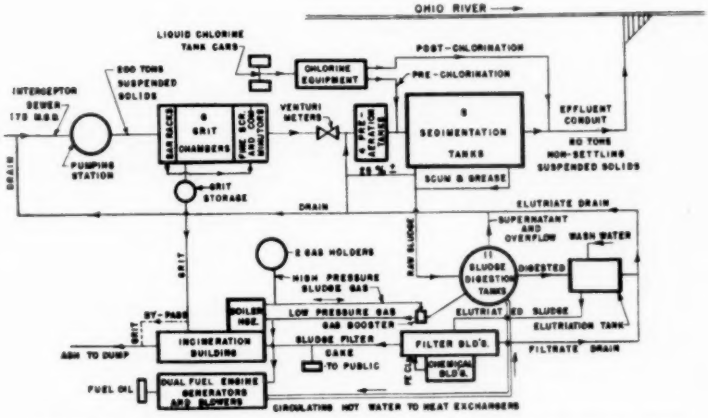

FIGURE 5.—Flow diagram of proposed central sewage treatment plant.

gheny River when conditions warrant. This project involves 14 sewage pumping stations, including the main pumping station at the treatment plant.

Project No. 2

Comprises three sewage treatment plants and 15 sewage pumping stations, including the main station located at the treatment plant, with corresponding intercepting sewer design.

Project No. 3

Comprises 5 sewage treatment plants and 16 sewage pumping stations, including a main pumping station at each of the treatment plants, with corresponding intercepting sewer system design.

Project No. 4

Comprises 11 sewage treatment plants and 19 sewage pumping stations, including a main pumping station at each of the treatment plants.

Cost Estimates

Preliminary designs and cost estimates were prepared for each of the projects for purposes of comparison. Prices for construction work could not be forecast into the future with any degree of safety or reliance. Cost estimates were prepared, therefore, on the basis of July, 1947 price levels according to the *Engineering News-Record* Construction and Building Cost Indexes. Operating costs likewise were prepared on a basis of wages prevailing in July, 1947.

Table IV shows the total costs of the four projects as based on a subaqueous construction design of the main intercepting sewer, where applicable.

Proper values were applied for renewals and repairs as annual operating charges for the various parts of the projects; thus giving a true measure of the annual burden, which includes also operating expenses, interest payments and debt retirement increments.

Choice of Project

The choice of a project is predicated not only on costs of construction and annual burden, but also on sound engineering merit and other intangible values.

The total project cost and annual burden studies indicate that the annual cost of Project No. 3, with five sewage treatment plants, is $143,000

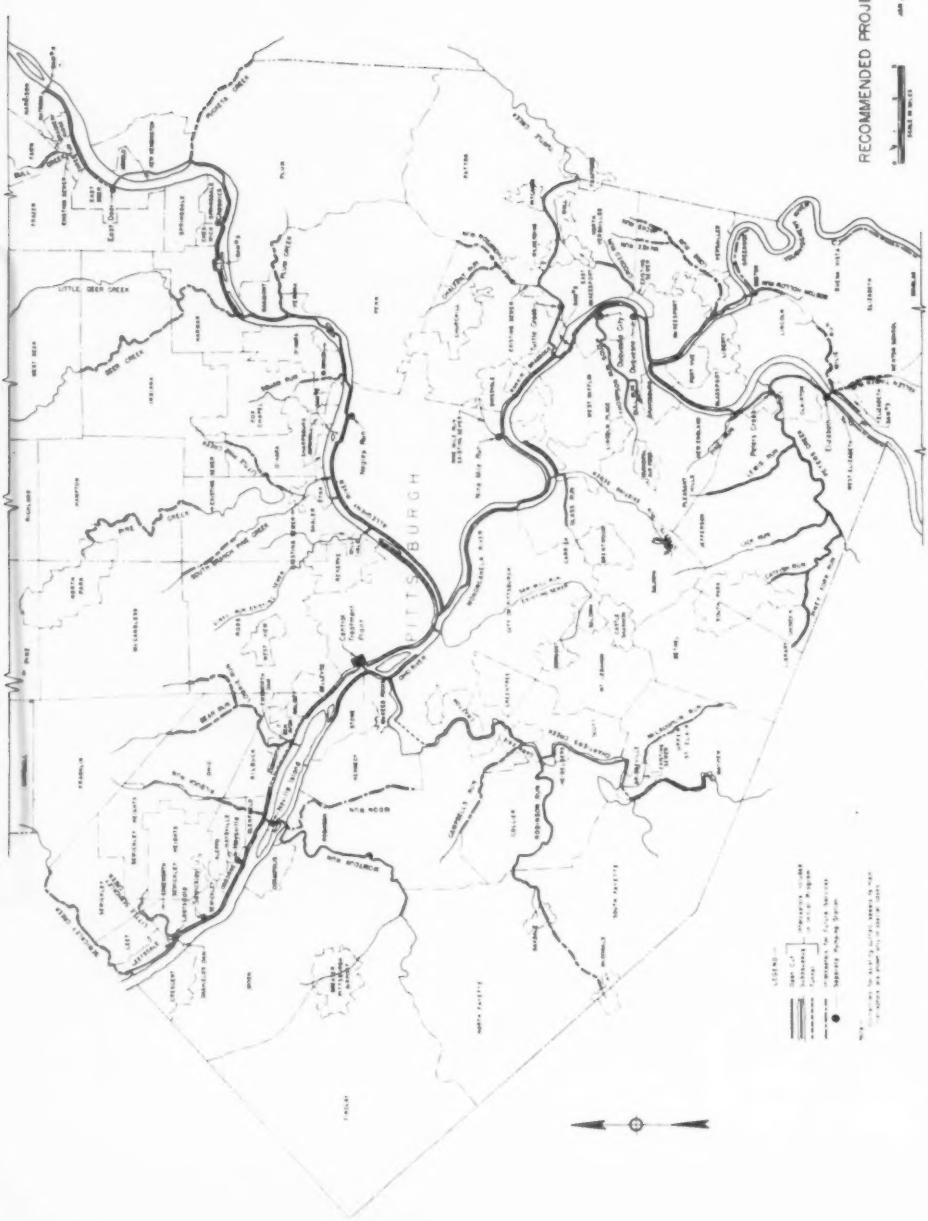

FIGURE 6.—Recommended plan of sewage collection and treatment for Allegheny County Sanitary Authority.

TABLE IV.—Comparison of Cost Estimates for Initial Program of Sewage Collection and Treatment Alternates

Item	Project No. 1 Central Plant	Project No. 2 Three Plants	Project No. 3 Five Plants	Project No. 4 Eleven Plants
Construction Cost (Incl. Contingencies and Overhead)				
Intercepting Sewers:				
On Four Principal Rivers	$51,002,000	$43,439,000	$41,012,000	$41,711,000
On Branch Streams	9,311,000	9,311,000	8,808,000	5,957,000
Revision of Old Regulators	182,000	182,000	182,000	182,000
Total Interceptors	$60,495,000	$52,932,000	$50,002,000	$47,850,000
Sewage Treatment Plants and Pumping Stations:				
Sewage Treatment Plants	$13,845,000	$16,578,000	$16,786,000	$19,244,000
Treatment Plant Pumping Stations	2,730,000	2,971,000	3,875,000	4,539,000
Separate Pumping Stations	3,982,000	3,111,000	1,863,000	1,582,000
Total Plants and Stations	$20,557,000	$22,660,000	$22,524,000	$25,365,000
Total Construction Cost	$81,052,000	$75,592,000	$72,526,000	$73,215,000
Land and Rights-of-Way	$ 530,000	$ 1,085,000	$ 1,173,000	$ 1,230,000
Prior Loans and Interest	$ 418,000	$ 418,000	$ 418,000	$ 418,000
Total Project Cost	$82,000,000	$77,095,000	$74,117,000	$74,863,000

less than Project No. 1, and that Project No. 2, with three sewage treatment plants, is $26,000 per year less costly than Project No. 1. Project No. 4 is $127,000 more costly annually than Project No. 1. The decision of the Authority engineers and Board and its consulting engineer has been that the merits and intangible values of Project No. 1 outweigh the calculated economic advantages of Projects Nos. 2 and 3 sufficiently to warrant the adoption of Project No. 1 with a central sewage treatment plant located on the Ohio River. A number of reasons for this decision and recommendation would include (1) fewer plants; (2) more efficient absorption and treatment of greater quantities of industrial wastes; (3) the freeing of the Pittsburgh harbor of sewage and industrial wastes as are transported to a central treatment plant farther downstream; (4) reduced peak loads; and (5) more efficient supervision by technical staff.

Revenue and Rate Studies

The requirement of the Municipality Authorities Act that rates shall be "reasonable and uniform" has been interpreted to mean that the rates shall be uniform by class. As a matter of policy the Authority has adopted rates to be applied uniformly to all municipalities participating in the Authority program regardless of their location and the actual cost of providing such service. This follows a general pattern set by electric and gas utilities and in most cases by water utilities where rates are uniform throughout the respective service areas in metropolitan districts.

Revenues must be sufficient to meet the annual burden and must be collectable to satisfy the bond buyer. The Allegheny County Sanitary Authority program is the largest sewage works project ever attempted for financing exclusively by means of revenue bonds, and therefore required considerable

study and consultation with financial interests to determine the conditions under which the bond issue to cover a project of this magnitude could be financed at a reasonably low rate of interest.

In evolving the rate schedule, it was found that a graduated scale of charges was the most equitable form, predicated on actual cost of services to each class of water user on the basis of sewage services. A calculation of the actual cost of revenue services to large users of the Authority system, based on a rational determination, produced a low rate of 7¢ per thousand gallons. In this determination due consideration was given to billing and collecting charges, infiltration, maintenance and operation of the Authority facilities under the various conditions.

The rates finally recommended to meet the annual burden of $4,869,000 under the recommended method of financing are as follows:

The first 100,000 gallons per quarter @ 18¢ per 1,000 gallons.
The next 1,000,000 gallons per quarter @ 12¢ per 1,000 gallons.
The next 2,250,000 gallons per quarter @ 09¢ per 1,000 gallons.
For all over 3,350,000 gallons per quarter @ 07¢ per 1,000 gallons.

Methods of Financing

Many studies were made of the various methods of financing the project under the Municipality Authorities Act. The report finally limited the financing possibilities to seven methods, four of which are possible under existing legislation and three requiring implementing legislation to produce the most economical results.

The method finally recommended involved proper agreements with municipalities for financing the program by means of partial sewage charges initiated promptly for the purposes of financing the cost of preparation of detailed plans and specifications, and continuing through the construction period in a measure according to financial requirements.

Acknowledgments

The Authority Board is appreciative of the guidance offered by the Board of Commissioners of Allegheny County under the Chairmanship of John J. Kane, which Board under the law created the Allegheny County Sanitary Authority; to Governor James H. Duff for his zeal and support of the stream clean-up program and for the grant which the Commonwealth made to the Sanitary Authority in the first phase of its operations by virtue of the Governor's action; to the Mayor and Council of the city of Pittsburgh and the Community Planning Division of the Federal Works Agency for financial aid to the Sanitary Authority; to Metcalf & Eddy, as Consulting Engineers of the Sanitary Authority; to the Consulting Estimators Mr. J. C. Knee and Mr. L. S. Stanley, who rendered important guidance in this period of difficult estimating; and to the entire staff of the Sanitary Authority which, under its Managing Engineer, Ellis E. Bankson, has proved loyal and capable in its support, making possible the consummation of the most important phase of a problem of sewage works planning which ranks with the most difficult in America.

ALLEGHENY COUNTY SANITARY AUTHORITY—A DISCUSSION

By Ellis E. Bankson

Managing Engineer, Allegheny County Sanitary Authority, Pittsburgh, Pa.

Following the broad picture of the Allegheny County project presented by Colonel Laboon, this discussion will touch upon the problem of financial matters and of the rate structure for sewer rentals.

The financial problem is, first, the favorable sale of sufficient bonds to meet all capital costs and, second, to establish a schedule of rates or charges for sewage works service that will produce enough revenue to cover the entire annual burden of debt service, operating costs, and administration expenses. The question of rate structure is that of equity between the several classes of customers.

The only type of bond which can be sold by a Municipal Authority in Pennsylvania is that of a revenue bond, which permits the pledge of only the revenues from such service operations as may apply and does not permit a pledge of the utility property, in the form of a mortgage, or of the municipality taxing power. Thus, it is the revenue of the Authority that constitutes the vital link with its investors, wherein each and every money requirement of such an Authority must be available, without fail, as operating revenues from the rate schedule.

It is therefore necessary that a 100 per cent revenue collection be assured and it is for this reason that the Authority recommended legislation to authorize the water shutoff privilege while the bond attorneys are proposing the alternate of a guarantee by the municipalities of all delinquent accounts by purchase of executed liens on the delinquent property. The cash results from property liens would be too slow for Authority finances, excepting by an excessive rate schedule in the beginning.

Regarding the type of schedule for sewer service rates or charges, we find in the Authority area some 50 types of water rate schedules which range all the way from \$1.25 to 20¢ per thousand gallons as the top rate and from something like 40¢ to 10¢ per thousand gallons as the bottom rate, in addition to flat rate charges for a third of Pittsburgh, and a few other municipalities.

Since the Municipality Authorities Act requires that rates be reasonable and uniform, it becomes evident that there can be no general relationship between these various water rates of the community and sewer rates of this Authority. Since there is available record of flat rate water fixtures to only a minor extent in the city and county, we would need develop all of that record for the adoption of any flat rate sewer revenue schedule, and we would look upon this as an antiquated type. The elimination of either a flat rate schedule or a percentage of the water charges leaves the one alternate of a schedule for sewer rates and charges on a quantity basis, for customer application.

For a concrete picture of magnitude, let us assume for simplicity that the construction cost of the initial project would approximate \$80,000,000 and that the debt service would approach 4½ per cent from a 3 per cent interest rate and a 40-year bond maturity. This would mean an annual burden of about \$5,000,000 from a debt service of some \$3,650,000 and an annual operating cost of \$1,350,000. The exact figure for each will depend on the method of final adoption. The financial problem is divided, therefore, into two phases: (1) a bond issue for some \$80,000,000 and (2) a uniform schedule of sewage charges which will produce some \$5,000,000 per year from something over 100 municipalities, of which nearly 60 per cent will apply within the city of Pittsburgh.

The question of equitable rates or charges against any sewer service is simply that of a uniform allocation from the aforesaid $5,000,000 per year as between the individual customers of the Authority.

By way of illustration, if we were to assume that an equivalent plant effluent of 73 billion gallons per year would cost $5,000,000, we would have an average unit cost of nearly 7¢ per thousand gallons, which 7¢ would apply for ground water infiltration and for some factor of storm water capacity in the same manner as for customer sewage. We should then allocate these separate costs back to each customer class in proportion to the origin of such extra costs, from the properties of each customer class, after due allowance is made for special charges and quality costs.

After deduction of special revenues and special costs, we find a remainder of quantity burden at $4,160,000 per year and ground water infiltration plus storm flow provision as equal to about ½ of the 73 billion gallons of annual load. The aforesaid annual quantity charge divided into the 73 billion gallons per year produces a cost of nearly 5.7¢ for actual plant influent or effluent, but this unit cost must now be carried back into the rate structure for application against the so-called revenue sewage that originates on the property of each customer—before addition of infiltration and storm water provision.

Careful analysis for Allegheny County indicates 120 g.p.d. of domestic sewage, from a normal household, 115 g.p.d. of ground water infiltration and 115 g.p.d. of storm water provision, or a total of 350 g.p.d. This 350 g.p.d. times 5.7¢ per thousand gallons, or less than 2¢ per day for 120 g.p.d. of domestic sewage, means a rate of 16.6¢ per thousand gallons of sewage from such residential property (the 350 g.p.d. figure applies only for this item of cost allocation and not for design purposes).

The cost allocation for quality treatment of this sewage is computed at $690,000 per year for 36,500,000,000 gal. of customer sewage, or less than 1.9¢ per thousand gallons. The sum of 1.9¢ for quality cost, and the aforesaid 16.6¢ for quantity cost, gives about 18.5¢ per thousand gallons for the collection and treatment of residential sewage.

In a similar manner we find the sewage flow from nine office buildings in Pittsburgh to be about 326,500,000 gal. per year, which is serviced by only 5220 lineal feet of sewer in the streets adjacent to those buildings. Out of these figures, we develop the ground water infiltration as only slightly over 1 per cent of the water sales. The addition of an equal amount for storm water capacity would show a charge against these buildings of only 333,700,000 gal. per year. A combination of quantity and quality costs, as above, would produce an annual cost of $25,224.40, or about 7.7¢ per thousand gallons of the aforesaid revenue sewage.

Thus we have a range of basis for an equitable rate schedule from 18.5¢ per thousand gallons for residental customers to 7¢ per thousand gallons for large quantities of commercial or industrial use, as compared to the proposed range of the Authority schedule from 18¢ to 7¢ per thousand gallons of sewage originating on the customer property, which will show substantial equity in combination with minimum charge for a small quantity and a surcharge for excess concentration.

The foregoing illustration is supported by careful over-all cost analysis by the Engineering Department, with the final result of an average cost allocation to each of the three representative groups at 18¢, 10¢ and 8¢ per thousand gallons of sewage originating upon the property of each customer type, as domestic, commercial, or industrial. The entire range above or below these averages is covered by the step schedule proposed by the Authority report at 18¢, 12¢, 9¢ and 7¢ per thousand gallons, respectively.

SHOULD PREVAILING SEWER RENTAL RATES BE ADJUSTED? *

By A. H. Niles

Engineer-Superintendent, Division of Sewage Disposal, Toledo, Ohio

Sewer rental in Ohio was made effective June 30, 1923 through enactment by the State Legislature of Section 3891—1 *et seq.* of the general code of Ohio. Prior to that time financing of sewage treatment plant construction was possible only by general obligation bonds, and operation funds were appropriated from the general fund.

It took several years for more than a very few municipalities to use the new means for financing operation of their plants. In 1927 there were 81 municipalities in Ohio with sewage treatment plants and only 4 used sewer rental. By 1940, 88 out of 216 used sewer rental, with 19 making plant improvements financed in whole or in part from that fund. In 1948 the total number of municipalities having sewage treatment plants had increased only 10 per cent to 236, but the number using sewer rental had increased 62 per cent to 143. At the present time 45 of the 143 municipalities are financing plant improvements in whole or in part from sewer rental charges; in addition several others are contemplating such a method. This is an indication of the present trend and interest in this subject.

The pertinent part of Section 3891–5 is hereby quoted as follows:

". . . This fund shall be used for the payment of the cost of the management, maintenance, operation and repair of the sewerage system and sewage pumping, treatment and disposal works and any surplus in such fund may be used for the enlargement or replacement of the same and for the payment of the interest on any debt incurred for the construction of said sewerage system and sewage pumping, treatment and disposal works, and for the creation of a sinking fund for the payment of such debt, but shall not be used for the extension of a sewerage system to serve unsewered areas or for any other purpose whatsoever."

From this examination of the law it will be noted that the first consideration is for operating funds, and that only *surplus* may be used for plant enlargement or replacement and for debt retirement.

Trends in Revenues and Operation Costs

Since funds for operation are of primary importance, the relative rates of increase of both revenue and of operating expense should be studied before new construction is considered. The data in Table I were secured from large, medium and small municipalities. All of the cities represented have complete treatment plants except Toledo. From the table it will be noted that revenues have in most cases increased very moderately but that the operating expenses, especially salaries and wages, have increased materially. This has been somewhat more noticeable in the larger cities than in the smaller ones, but all sewage plants will experience the same effect in time.

Six Ohio cities above 100,000 population use sewer rental with an average minimum annual rate of $3.10; Akron with $6.00 is the highest and Toledo with $1.20 is the lowest. Ak-

* Presented at 22nd Annual Meeting, Ohio Sewage and Industrial Wastes Treatment Conference, Dayton, June 23–25, 1948.

TABLE I.—Sewer Rental Revenue and Operating Expense Data for Nine Ohio Cities

City (1940 Population) [Min. Annual Sewer Rental Charge]	Year	Sewer Rental Revenue ($)	Increase from Base Year (%)	Total Income ($)	Operation Salaries and Wages ($)	Total Number Employees	Average Yearly Salary ($)	Increase from Base Year (%)	Total Operating Expense ($)	Increase from Base Year (%)	Total Oper. Cost per M.G. Treated ($)	Increase from Base Year (%)
Cleveland[1] (878,336) [$1.84]	1942	1,001,974	—	1,025,972	538,164	259	2,078	—	889,582	—	15.41	—
	1943	1,160,809	15.8	1,295,164	584,017	247	2,364	13.8	969,093	8.9	15.94	3.4
	1944	1,307,874	30.6	1,360,489	582,604	235	2,479	19.3	980,283	10.2	17.24	11.8
	1945	1,258,599	25.6	1,427,362	600,289	230	2,610	25.6	1,014,524	14.1	17.04	10.6
	1946	1,277,151	27.5	1,338,056	593,281	227	2,614	25.8	999,744	12.4	17.60	14.2
	5-Yr. Ave.	1,201,128	20.0	1,289,409	579,671	240	2,429	17.0	970,647	9.0	16.65	8.0
Columbus (306,087) [$1.56]	1943	457,325	—	469,050	142,089	69.5	2,045	—	326,550	—	17.58	—
	1944	487,800	6.4	499,850	132,263	65.2	2,030	−0.1	272,550	−16.5	15.40	−12.4
	1945	485,575	6.2	503,300	125,801	61.6	2,055	0.1	272,925	−16.4	18.30	4.1
	1946	531,700	16.0	563,575	134,221	59.3	2,265	10.7	305,875	−6.3	19.92	13.3
	1947	569,575	24.6	603,775	144,232	59.7	2,420	18.3	320,450	−1.9	23.10	40.7
	5-Yr. Ave.	506,395	10.7	527,910	135,721	63.1	2,150	5.1	299,670	−8.2	18.86	7.3
Toledo (282,349) [$1.20]	1943	235,031[3]	—	244,722[2]	116,841	55	2,120	—	141,380	—	10.35	—
	1944	246,844	5.1	275,760	136,786	55	2,480	17.9	160,865	13.8	11.92	15.2
	1945	237,315	1.0	260,266	142,537	55	2,590	22.0	169,645	20.0	12.14	17.3
	1946	239,246	1.8	264,678	158,307	56	2,830	35.5	188,650	33.5	14.11	36.3
	1947	260,058	10.6	277,214	173,447	58	2,990	48.5	209,488	48.2	12.37	19.5
	5-Yr. Ave.	243,299	3.5	264,526	145,590	56	2,602	22.7	174,005	23.0	12.17	17.5
Lima (44,711) [$2.40]	1943	44,492	—	44,608	21,080	12	1,755	—	37,641	—	13.33	—
	1944	42,009	−5.6	42,157	22,983	12	1,913	9.0	36,984	−1.8	13.16	−1.3
	1945	41,791	−6.1	41,845	27,812	13	2,140	21.9	43,754	16.2	18.05	35.4
	1946	40,000	−10.1	40,069	31,842	13	2,448	39.5	48,097	27.7	18.35	37.7
	1947	41,641	−6.4	41,847	31,086	12	2,590	47.6	45,760	21.5	16.42	23.2
	5-Yr. Ave.	41,987	−7.1	42,105	26,961	12	2,169	29.5	42,447	15.7	15.86	23.8
Alliance (22,405) [$5.40]	1943	23,200	—	23,200	11,944	6.5	1,840	—	20,988	—	24.35	—
	1944	26,461	14.1	26,461	13,059	6.5	2,010	9.2	22,637	7.9	27.10	11.8
	1945	23,599	1.7	23,599	14,057	6.5	2,170	17.9	23,922	14.0	26.10	7.2
	1946	29,150	25.7	29,150	15,987	6.5	2,460	33.7	27,075	29.1	28.05	15.2
	1947	44,253[3]	90.7	44,253[3]	17,640	6.5	2,710	47.2	28,130	34.1	29.50	21.1
	5-Yr. Ave.	29,333	21.0	29,333	14,537	6.5	2,238	21.6	24,550	17.0	27.02	11.0

TABLE I.—Continued.

City (1940 Population) [Min. Annual Sewer Rental Charge]	Year	Sewer Rental Revenue ($)	Increase from Base Year (%)	Total Income ($)	Operation Salaries and Wages ($)	Total Number Employees	Average Yearly Salary ($)	Increase from Base Year (%)	Total Operating Expense ($)	Increase from Base Year (%)	Total Oper. Cost per M.G. Treated ($)	Increase from Base Year (%)
Findlay (20,228) [$4.80]	1943	33,136	—	33,136	15,554	8	1,940	—	19,751	—	25.38	—
	1944	34,165	3.1	34,165	14,605	7	2,090	7.7	17,395	−11.9	23.10	−9.0
	1945	34,736	4.8	34,736	14,303	6	2,390	23.2	18,295	−7.4	25.30	−0.3
	1946	36,499	10.8	36,499	16,434	6	2,740	41.2	18,737	−5.1	20.61	−18.8
	1947	38,143	15.1	38,143	17,810	6	2,970	53.1	20,206	2.3	21.62	−14.8
	5-Yr. Ave.	35,336	6.6	35,336	14,401	6.6	2,670	37.7	18,877	−4.4	23.08	−9.1
Bowling Green[2] (7,190) [$6.00]	1942	20,302	—	20,302	10,422	7	1,490	—	17,627	—	47.10	—
	1943	19,945	−1.8	19,945	11,324	5.5	2,060	38.3	17,315	−1.8	45.15	−4.1
	1945	18,965	−6.6	18,965	7,392	5.5	1,350	−9.4	15,177	−13.9	42.90	−8.9
	1946	19,325	−4.9	19,325	8,720	5.5	1,600	7.4	15,497	−12.1	32.08	−31.9
	1947	21,794	7.3	21,794	11,060	5.5	2,010	34.9	20,616	17.1	42.50	−9.8
	5-Yr. Ave.	20,066	−1.1	20,066	9,784	5.5	1,702	14.2	17,246	−2.2	41.95	−10.9
Wauseon (3,016) [$8.00]	1943	11,114	—	11,114	1,995	1.25	1,600	—	4,640	—	38.30	—
	1944	11,010	−0.9	11,010	2,410	1.5	1,610	0.6	5,435	17.2	50.10	30.9
	1945	11,634	4.7	11,634	3,594	1.75	2,050	28.1	6,615	42.6	47.20	23.2
	1946	11,933	7.4	11,933	3,464	1.75	1,980	23.8	6,510	40.3	50.80	32.6
	1947	12,729	14.5	12,729	4,449	2.0	2,225	39.0	8,188	76.5	52.15	36.1
	5-Yr. Ave.	11,684	5.1	11,684	3,183	1.65	1,930	20.7	6,278	35.3	47.71	24.6
Lancaster (21,940) [——]	1943	13,219	—	13,219	—	5[4]	1,776	—	13,179	—	—	—
	1944	15,219	15.1	15,219	—	5[4]	1,880	6.0	13,213	0.3	—	—
	1945	15,217	15.0	15,217	—	5[4]	1,940	9.2	13,826	4.9	—	—
	1946	16,147	22.1	16,147	—	5[4]	2,060	15.9	17,914	35.9	—	—
	1947	20,287	53.4	20,287	—	5[4]	2,292	29.0	18,852	43.0	—	—
	5-Yr. Ave.	16,018	21.2	16,018	—	5[4]	1,990	12.1	15,397	16.9	—	—

[1] Data for three plants.
[2] 1944 figures not available.
[3] Adjusted for increase in rates.
[4] Part-time clerk and supervisor not included.

ron's rate, effective in January, 1947, was based upon the funds required for operation and administration which in 1947 amounted to $320,000, plus amortization of the estimated cost of sewage treatment improvements amounting to $5,100,000. These improvements were not made then and are today estimated at $9,000,000. A rate that seemed adequate a year and a half ago is today totally inadequate. Cincinnati, which is not included in the above, will have sewer rental by the end of June, 1948.

There are 11 Ohio cities from 100,000 to 20,000 population using sewer rental. They have an average minimum annual rate of $4.07, with the highest rate $6.00 and the lowest $2.00. Thirty cities from 20,000 to 5,000 population, having sewer rental, have an average minimum annual rental of $4.35 with $9.00 the highest and $1.00 the lowest. There are 92 villages with sewer rental and the average minimum annual rate is $5.94 with $18.00 the highest and $2.00 the lowest.

From these figures it is seen that there is a wide variation in the rates, due in large measure to the amount of original plant construction cost amortized from sewer rental funds. After the construction costs are once determined, the money required to meet annual principal payments and for the interest on the unpaid balance is easily computed. The more difficult part is to estimate rationally operating costs over a period of years. These are made up from "personal services" or payroll, and "other expense." In the latter are included costs of light and power and of supplies and repairs.

It will be noted from Table I that with two exceptions the average percentage increase in salaries and wages alone has exceeded the normal increase in revenue, unless the rate has recently been increased. In practically all cases "personal services" bear a closely fixed percentage of the total operating expense. This varied from about 60 per cent, where the average annual wage per employee was relatively low, to 85 per cent, where the average wage was higher. In the three cases in the table where operating expense showed a consistent decrease from the base year, it was due to a reduction in the number of operating personnel. One can only surmise that some part of the operation of these plants must have been curtailed, because it seems unlikely that greater efficiency of operators could make up for the fewer numbers. Decreasing the number of operators does not seem to be the right answer to the problem unless the plant was originally overstaffed. This seems unlikely.

Trend in Construction Costs

Where a municipality is using or expects to use surplus funds to finance improvements, a great deal more care is required when examining existing or proposed rates. The *Engineering News-Record* Index is a quick but rather rough method of comparing cost estimates at any given time for general construction work. The base (100) of this index represents the average of construction costs as of 1913. Figures are readily available as to the index at any given time. For example, in the year 1930 it was 202.85 or 2.0285 times the 1913 cost. By 1938 it was 235.86. For 1943 it was 289.95 and for 1947 it was 407.12. In May, 1948 the index was 447.86.

In Toledo, preaeration and grease removal facilities were designed in 1944 and the cost was estimated at $150,000. These units were not constructed because of difficulties in obtaining equipment and materials. Today it is doubtful whether these same units could be built for less than $300,000.

It has been felt for some time among some sanitary engineers that the ENR Index should not be applied without a factor when estimating sewage treatment plant costs. The index represents the average of construction costs

in such diverse projects as water plants and distributing systems, dams and irrigation works, bridges, airports and paving, as well as sewers, sewage treatment plants and appurtenances. The building cost index is somewhat lower than the average where construction of industrial buildings is the principal work involved and other items are only incidental. It is readily seen that sewage works, with their prevailing construction difficulties of depth, ground water, poor foundation conditions in many cases, relatively complicated and costly concrete form work and costly mechanical equipment, involve higher than average construction costs.

A consulting engineer has made available to the writer a detailed study of two typical sewage treatment jobs where unit prices were used instead of lump sums. One plant was built in 1930 and the other in 1938. The actual costs of these plants were compared with their present estimated costs based on 1948 unit prices bid on jobs of such similar nature as to be directly comparable. At 1948 unit prices, the 1930 plant showed a cost 2.75 times as high as the actual, and the 1938 plant came to 2.60 times the original cost. By referring to the ENR Indexes, it is found that the figures of 202.85 and 235.86 are listed for the years 1930 and 1938, respectively. By applying these figures, instead of the unit price figures as above, present day costs of 2.21 and 1.90 times the actual costs of 1930 and 1938, respectively, would be the result. It thus would seem that the ENR Index should be increased by about 24 per cent in the case of the 1930 plant and by about 36 per cent for the 1938 plant. Suppose the average is taken to be 30 per cent, then the factor sought would be 1.30, which would be applied to ENR construction cost estimates. Of course, two cases are not sufficient to establish this factor, but if it is in error, it would seem to be in error on the safe side. If sewer rental rates are established to provide funds to amortize estimated costs of plant additions, the above factor should also be on the safe side.

Each particular municipality must make its own individual study to determine the rate of increase in revenue from sewer rental that can reasonably be expected due to increased use of facilities. At the same time an increase in operating expense must also be anticipated. A reserve fund should be provided to absorb the increase in cost of structures and equipment when these must be replaced.

Industry and public utilities do this as standard practice. In late years their financial statements show increasingly greater reserves for replacement of facilities. Such provision for higher reserves should also be made when sewer rentals are expected to finance plant additions and replacements.

To illustrate the application of the 1.3 factor to the ENR Index, assume that the cost of sewage treatment plant additions and improvements was carefully estimated at $100,000 in 1940; then in 1945 that same construction would have cost $165,000; in 1946, $186,000; in 1947, $218,000; and at the present time $241,000.

Summary

In summation, it seems almost inescapable that with third-round wage increases setting the national pattern, sewage works wages will also increase further. The rapidly rising cost of personal services, rising costs of all supplies and repairs, and only moderate gains of revenue from sewer rental, point to the fact that it will not be long before the rates must be revised upward. When construction of plant additions or expansion of any magnitude is considered, any rate thought to be sufficient to cover all costs involved a year or so ago is totally inadequate today. What seemed

like a fantastic rate a few years ago will not take care of present day conditions.

It will be well for each plant superintendent and municipal finance official to ask how much longer can present rates bring in revenues which will not only pay normal operational costs but also purchase major pieces of equipment or rebuild structures when they are no longer serviceable? In some cities—Alliance, for example—that question has already been asked. The answer was to increase sewer rental rates by 80 per cent in June, 1946. Many other Ohio cities must follow if sewage plants are to be kept functioning properly.

STANDARDS FOR OHIO RIVER AT CINCINNATI

Taking its first action to establish sewage treatment requirements on interstate waters, the newly established Ohio River Valley Water Sanitation Commission has called for "substantially complete removal of settleable solids and 65 per cent reduction of biochemical oxygen demand" in organic wastes discharged into the Cincinnati Pool during periods of low flow. The latter is a 22-mile stretch of the Ohio River between navigation Dams 36 and 37.

The recommendations were detailed at a public hearing in Cincinnati on February 16. No protests were offered despite the fact that the requirements are higher than the minimum of 45 per cent removal of total suspended solids (about 35 per cent B.O.D. reduction) as set forth in the Compact of eight states under which the Commission functions. The Compact provides, however, that higher standards may be promulgated wherever this may be found necessary. In fact, so strong is public sentiment for stream-pollution abatement in this area that municipal officials, on whom will fall the burden of complying with the recommendations, expressed themselves as unanimously in favor of the requirements.

The Cincinnati pool standards, states Hudson Biery, chairman, will become effective upon adoption by the Commission, which is to meet on April 6.

The pool, which receives the discharge of wastes from Cincinnati and several northern Kentucky communities, including Covington, also serves as the raw water supply for these cities.

Corrective measures for pollution control in the pool already are underway. Cincinnati proposes to ask for construction bids in July on one of two projected sewage treatment plants. Plans have been prepared by Havens and Emerson, consulting engineers. To aid in financing the work the city put into effect a sewer rental ordinance last summer which thus far has produced funds of about a million dollars.

On the Kentucky side of the river, Covington and neighboring communities have joined together in forming a sanitation district. Comprehensive plans for joint sewage treatment facilities are now being developed by Vogt, Ivers and Seaman, consulting engineers.

For purposes of treatment-plant design the committee established a water quality objective of 4.0 p.p.m. of dissolved oxygen at the bottom of the oxygen sag curve for the Ohio River below Cincinnati.

FILTER PAPER METHOD FOR SUSPENDED SOLIDS DETERMINATION *

By K. Fraschina

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Suspended solids in sewage are defined arbitrarily in "Standard Methods" (1) as the weight of solids removed by filtration through an asbestos mat in a Gooch crucible or through a filter paper in an aluminum dish. The proportion of solids removed obviously depends on the fineness of the filter, and perhaps on the rate of filtration, volume filtered per unit area, kind of filter media, thickness of mat, and degree of mechanical entrapment or sorption of the finer particles in the interstices of the filter. The value of the test method for estimating plant loadings and operating efficiencies will be increased as variability from these sources is decreased.

This paper describes a modified filter paper method which has been used at the Richmond-Sunset plant for several years. The modification is believed to be an improvement on the standard aluminum dish method, and is superior to the standard Gooch crucible method in time required for filtration and ease of manipulation. The modification consists essentially of (1) elimination of the aluminum dish and (2) the use of blank papers to correct for changes in sorbed water. For convenience, the modified method will be referred to hereafter as the "filter paper" method.

The use of sintered glass or porous bottom porcelain crucibles was considered but was discarded after a few trials because the rate of filtration is no better than with a Gooch crucible, and thorough cleaning after use is difficult.

The method described here recognizes the following characteristics of filter paper that might affect results:

1. Oven dried filter paper is extremely hygroscopic. The weight of sorbed water depends on time of exposure, humidity, and temperature of atmosphere in which the paper is exposed. Sorption may be appreciable even when the paper is placed directly in a desiccator.
2. Sorbed atmospheric moisture can be removed, for all practical purposes, by drying one hour at 103°C. Up to 24 hours' drying at 103°C. may be required to remove all traces of sorbed water after the paper is wet. The difference appears to depend on whether moisture is adsorbed or absorbed.
3. All papers in a set will gain or lose the same amount of sorbed moisture, so long as they are all subjected to the same conditions of drying and exposure.

For these reasons, initial and final weighings are made after papers are exposed to room atmosphere for one hour after oven drying, and blank papers are used to correct for changes in sorbed water between initial and final weighings.

Method

Apparatus

Filter paper, Whatman No. 1, 9 cm. diameter.

Büchner funnel, size 2A.

* Presented at 1948 Annual Meeting, California Sewage Works Association, San Diego, June 18, 1948.

Standard filter flask with side tube, 1,000 ml.

Special 100-ml. wide-mouth pipette, 7.5 mm. I.D. at tip (Rascher & Betzold, Inc., Chicago, No. R-215-00).

Procedure for Total Suspended Solids

1. Place filter papers in oven so that they do not overlap or touch, and dry one hour at 103°C. (uniform temperature throughout oven). Include two blank papers. If some but not all papers in set are or have been wet previously, dry set in oven 24 hours at 103°C.

2. Distribute papers on balance table so that papers do not touch or overlap. After one hour, weigh to 0.1 mg. in random sequence.

3. Place paper smooth side up (for faster filtration) in Büchner funnel, wet with distilled water, and apply about 20 in. vacuum to flask. Using special pipette, transfer 100 ml. well-mixed sewage to funnel, taking care to keep solids in suspension while measuring (mechanical mixing preferable). Rinse pipette with several small portions of distilled water and add rinsings to the paper. Be sure all suspended matter is transferred. After water is extracted, wash any particles adhering to sides or bottom of funnel onto paper and wash paper with distilled water. Stop suction, and remove paper from funnel with forceps.

4. Repeat step 3 with blank papers using distilled water only.

5. Place papers and blanks in oven at one time, distributing as in step 1, and dry one hour at 103°C.

6. Repeat step 2.

7. Apply average change in weight of blanks from step 2 to step 6 as a correction to all other papers in set. Subtract correction if blanks have gained weight; add correction if blanks have lost weight.

Example of Calculation

Weights of paper in milligrams; 100-ml. sample filtered:

	Blanks		Sample	
Final wt. (step 6)	563.7	529.8	563.2	559.8
Initial wt. (step 2)	561.7	528.2	542.8	537.6
Difference	2.0	1.6	20.4	22.2
Average	1.8		21.3	

Suspended solids in sample
$= (21.3–1.8)\ 1000/100 = 195$ p.p.m.

In regular routine work, steps 1 and 2 can be carried through on the day preceding steps 3 to 6. This procedure saves time and is the one normally used in this laboratory. Changes in the blanks are usually in the range of 1 to 5 mg., but occasionally may be as high as 10 mg. Room relative humidity is normally in the range of 45 to 65 per cent and room temperature 60° to 75° F.

Experimental

Sorption of Water Vapor by Filter Paper

Sorption curves for oven dried blank filter paper and filter paper plus suspended solids from asparagus cannery waste are shown in Figure 1, curves A and B, respectively.

Data for these curves were obtained by oven drying each paper one hour at 103°C., cooling in a desiccator containing fresh calcium chloride, transferring to the pan of a projection reading balance, and weighing immediately and at short intervals thereafter.

The gain in weight is very rapid at the start, but quite slow after one hour. In fact, the initial rate of gain is faster than can be measured by the usual analytical balance. This explains why precision is low if extreme precaution is not taken when papers are weighed directly after cooling in a desiccator. Moreover, another source of error is introduced if more than one paper is placed in the desiccator, namely, the entry of moist air each time the cover is removed.

Note that curves A and B are virtu-

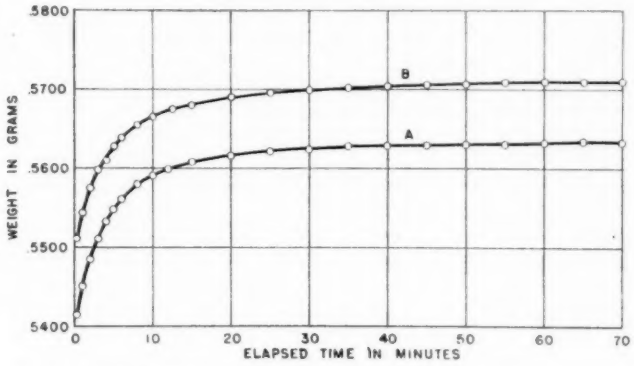

FIGURE 1.—Sorption of moisture by dry filter paper.

TABLE I.—Comparison of Results by Direct Weighing from Desiccator Against Weighing after One Hour Exposure to Atmosphere

Day	Suspended Solids (p.p.m.)				Range of Duplicates (0.1 mg.)					
	Raw		Effluent		Direct			1-Hr.		
	Direct	1-Hr.	Direct	1-Hr.	Blk.	Raw	Eff.	Blk.	Raw	Eff.
1	229	261	43	45	24	32	12	3	9	1
2	222	256	74	84	31	1	37	2	10	3
3	313	258	135	97	102	5	30	2	20	4
4	217	264	205	167	3	34	78	3	14	20
5	101	105	48	44	11	0	16	7	4	0
6	134	142	92	65	74	3	58	15	7	7
7	417	430	130	141	31	70	29	0	64	8
8	414	399	134	140	8	63	27	9	13	1
9	215	219	90	100	39	27	12	0	1	3
10	270	236	119	105	25	16	34	13	0	22
Av.	253	257	107	99	35	25	33	5	14	7
Diff.	4		−8							
t	0.38		1.20							
P	0.7		0.25							

ally parallel after 5 min. elapsed time. This indicates that both papers are gaining weight at the same rate. Nor is there any detectable sorption by the dried suspended solids on paper B.

Effect of Atmospheric Exposure

Table I gives comparative suspended solids obtained by first weighing papers directly from the desiccator and reweighing after allowing the papers to stand on the balance table one hour, with corrections applied for changes in blank papers carried through the same steps simultaneously. The samples analyzed were regular 24-hour refrigerated composites of raw sewage and primary effluent on ten consecutive days. The results are not typical of normal plant operations because of interference from construction work during this period. An individual 4-in. aluminum desiccator containing freshly regenerated activated alumina was used for each paper. All determinations were made in duplicate. The values in the table are averages of the duplicates.

The statistic t (2) is computed to determine whether the average difference between the immediate and delayed weights is statistically significant. P is the associated probability. In neither case does the value of P approach the significance level of 0.05. It can be concluded, therefore, that there is no difference in the results obtained by the two methods of weighing. The data indicate also that within the precision of the method there is no detectable sorption of moisture by dried suspended solids on the papers during the one-hour exposure to room atmosphere.

Note, however, that (a) the average range of duplicates is much less in the delayed weights than in those determined immediately, indicating that precision is much better when weighing after atmospheric exposure, and (b) blank corrections are necessary even when papers are weighed directly from the desiccator.

Recently a few tests were made in which the filter paper was dried and weighed in a covered aluminum dish. The cover was removed during drying, but was replaced before removing the dish from the oven. The covered dish was cooled in a desiccator before weighing. The method shows promise if tight-fitting covers are used, for sorption of atmospheric moisture is practically eliminated. The method may have particular application when the dried suspended solids on the filter paper sorb significant quantities of moisture on one-hour exposure to room atmosphere.

Drying Time for Complete Removal of Sorbed Moisture from Wet Filter Paper

Ten filter papers from the same box, arbitrarily divided into two groups 1 to 5 and 6 to 10, were carried through a simultaneous series of dryings (at 103°C.) and weighings. All weighings were made after one hour exposure to room atmosphere on the balance table. The gain or loss from the initial weight was calculated for each paper at each weighing. From these differences, the average difference d_1 for group 1 to 5, and d_2 for group 6 to 10 were calculated. According to statistical theory, all values of d_1-d_2 should be within control limits when plotted on a control chart (3) unless there are assignable causes of variation.

The control chart is shown in Figure 2. All points for standard deviations (of a single difference) lie within control limits. All points for d_1-d_2 up to point x are in control limits. At point x papers 1 to 5 but not papers 6 to 10 were wet with distilled water before drying. Twenty-four hours additional drying was necessary before the points were again in control limits. At points y and z all ten papers were wet with distilled water before drying, without effect.

Evidently prolonged drying is required for complete removal of sorbed water after wetting. It is for this

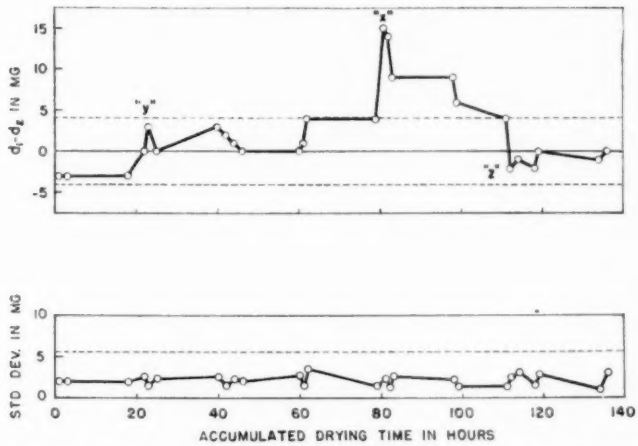

FIGURE 2.—Control chart; studies of drying time of wet filter papers.

TABLE II.—Effect of Mat Thickness and Vacuum Applied in Gooch Method

Mat Thickness (mm.)	Susp. Solids (p.p.m.)	
	Vac. A	Vac. B
3	80	86
	92	96
	94	84
	86	82
	Av. 88	87
2	72	72
	88	68
	84	88
	84	84
	Av. 82	78

reason that an error is introduced if the blank papers are not wet before the second drying in the filter paper method.

Effect of Mat Thickness and Vacuum Applied in Gooch Method

The effect of mat thickness within the limits specified in the Eighth Edition of "Standard Methods" and the degree of vacuum were investigated simultaneously using a randomized block arrangement (5) as illustrated in Table II. The sample size was 50 ml. Two thicknesses of asbestos mat, 2 mm. and 3 mm., in 25-ml. Gooch crucibles, were investigated. The dry weights of the mats were approximately 0.17 and 0.27 gm., respectively. Vacuum A was obtained by connecting the filter flask to a previously evacuated gallon flask, in turn connected to the filter pump so that a vacuum of over 25 in. was maintained during the entire course of the filtration. Vacuum B was obtained by connecting the filter flask directly to the filter pump. The vacuum rose during the course of the filtration from about 2 in. to about 25 inches.

An analysis of the variance of the data presented in Table II follows:

	Sum Squares	Degrees Freedom	Mean Square
Between vacuums	6.25	1	6.25
Between mats	56.25	1	56.25
Residual	165.25	13	12.71

$$F \text{ between vacuums} = \frac{6.25}{12.71} = <1 \text{ (not significant)}$$

$$F \text{ between mats} = \frac{56.25}{12.71} = 4.43; P = 0.05+$$

Since P for the comparison between mat thickness is practically at the 0.05 level of significance, it can be concluded that thickness of mat but not the degree of vacuum affects the numerical value of the suspended solids obtained. In the Ninth Edition of "Standard Methods" the thickness of the asbestos mat has been doubled. It is therefore reasonable to expect that higher numerical values will be obtained than heretofor.

Comparison of Gooch and Filter Paper Methods

Table III shows suspended solids on parallel analyses for ten successive days on regular 24-hour refrigerated composites of raw sewage and primary effluent by the Eighth Edition of "Standard Methods" Gooch crucible method (column A), and the filter paper method (column B). The mat thickness used in the Gooch crucible was 3 mm. (approximately 0.27 gm. dry weight of asbestos). Samples of 100 ml. were filtered through the filter papers, and 50 ml. through the Gooch crucibles. All determinations were made in duplicate. The values given in the table are averages of the duplicates.

TABLE III.—Comparison of Gooch and Filter Paper Methods of Suspended Solids Determination

Day	Suspended Solids (p.p.m.)					
	Raw Sewage			Primary Effluent		
	A	B	A-B	A	B	A-B
1	262	253	9	69	40	29
2	280	273	7	74	61	13
3	303	272	31	80	68	12
4	294	282	12	104	62	42
5	301	297	4	89	76	13
6	291	292	−1	81	49	32
7	276	309	−33	66	83	−17
8	332	303	29	103	75	28
9	381	350	31	100	43	57
10	418	363	55	80	26	54
Av.	313.8	299.4	14.4	84.6	58.3	26.3
t for A-B	1.92			3.74		
P	0.09			0.01 −		

Using $P = 0.05$ as the significance level, there is no significant difference between the Gooch crucible method and the filter paper method for raw sewage, but there is a significant difference for primary effluent, the filter paper method giving definitely lower values.

There are several possible explanations. First, the thickness of the mat in the Gooch crucible affects the proportion removed, as shown previously. Second, the surface area of the filter paper is twelve times as great as the Gooch filter. Since twice as much sample was filtered through the papers, the relative volume filtered per unit surface area was six times as much in the Gooch filter. Apart from effect of thickness of the mat, it is reasonable to expect more mechanical entrapment and sorption of the finer particles as the number of particles filtered per unit area is increased, particularly in view of the tendency of Gooch filters to clog easily.

Summary

The often excessive time required for filtration and the frequency of clogging are well-known limitations of the Gooch crucible method for suspended solids. Less well known is the dependence of the numerical value obtained on the thickness of the asbestos mat.

The aluminum dish method is more rapid than the Gooch crucible method, but is subject to large errors from sorption of water unless extreme precautions are taken in weighing.

In the filter paper method described here, errors from sorption are minimized by weighing after one hour exposure to room atmosphere and by inclusion of blank papers to correct for changes in sorbed water between weighings. Sorption by the dried suspended solids on the paper does not

appear to be appreciable during exposure to the atmosphere.

Acknowledgment

The author gratefully acknowledges the help of Benn Martin, formerly of this plant, and V. Camarena, who did most of the experimental work, and of R. McNeil of the California Packing Corporation, who furnished the data for Figure 1.

References

1. "Standard Methods for the Examination of Water and Sewage," Ninth Edition, pp. 145 and 157. American Public Health Association, New York, N. Y. (1946).
2. Freeman, H. A., "Industrial Statistics," p. 14, John Wiley and Sons, New York, N. Y. (1942).
3. "A.S.T.M. Manual on Presentation of Data," pp. 47–54, American Society for Testing Materials, Philadelphia, Pa. (1940).
4. "Standard Methods of Water Analysis," Eighth Edition, p. 160, American Public Health Association, New York, N. Y. (1936).
5. Brownlee, K. A., "Industrial Experimentation," pp. 10 and 46, Chemical Publishing Company, Inc., Brooklyn, N. Y. (1947).

BIOLOGICAL RESEARCH BY USPHS

The biological phases of the pollution research program of the Environmental Health Center at Cincinnati are being enlarged to meet responsibilities placed upon the Public Health Service by the newly-enacted Water Pollution Control Act (Public Law 845), according to Assistant Surgeon General Mark D. Hollis, Chief of Engineering Activities of the Public Health Service, Federal Security Agency.

This research is being centered in the Biology Section of the Center's Research and Development Division, and is carried out under the direction of Senior Scientist S. M. Tarzwell. Both laboratory and field investigations are planned.

Proposed studies are grouped under three subsections. One is concerned with problems of water supply, and of the role of algae, protozoa or other plankton organisms in the natural purification of streams and in waste treatment processes. A second subsection will make similar studies of the role of various organisms found in muds and other bottom deposits, the effects of industrial wastes on these organisms, and methods of overcoming adverse effects. The third subsection will carry on bio-assay for the determination of the toxicity of various wastes to fishes and for the development of methods for determining the cause of death. It will also develop water pollution survey techniques and methods.

The Environmental Health Center (formerly known as the Water and Sewage Investigations Station) is under the immediate supervision of Sanitary Engineer Director Vernon G. MacKenzie. The Research and Development Division is directed by Head Bacteriologist C. T. Butterfield.

A CRITICAL REVIEW OF THE LITERATURE OF 1948 ON SEWAGE AND WASTE TREATMENT AND STREAM POLLUTION

By W. Rudolfs, *Chairman*, H. E. Babbitt, D. E. Bloodgood, G. P. Edwards, E. F. Eldridge, H. A. Faber, A. L. Genter, H. Heukelekian, H. J. Miles, F. W. Mohlman, H. Orford, C. C. Ruchhoft, C. N. Sawyer, L. R. Setter, L. W. Van Kleeck

Committee on Research, Section A, Federation of Sewage Works Associations

Although space limitations make it necessary to condense the annual review this year, approximately the same number of references were reviewed. The committee has made special effort to follow the same pattern of previous years—to indicate the progress made, to provide an evaluation of published contributions, to call attention to published material not readily available, and to provide a comprehensive bibliography for convenient reference.

Attention is called to the increase in articles reviewed pertaining to trade wastes. Ten years ago the number of papers reviewed were 45, whereas this year there were 110 papers considered of sufficient interest to be reviewed. Most of the expanded interest pertaining to industrial wastes in the United States has come during the last few years, as indicated by the papers reviewed. About half of those reviewed in 1938 were published abroad. In the present review only a fraction of these papers were published outside the United States. The growth in interest, as shown by the number of papers published, made it necessary to have several reviewers cover this subject. The widespread interest in industrial wastes, their treatment and effects on streams is also indicated by the review section dealing with stream pollution. The problems of administration, stream classification and particularly workable stream pollution abatement regulations which are being developed require policies in regard to standards which must be flexible and fairly definite at the same time. Whereas industry can probably develop controls and methods for its own waste treatment, close cooperation between regulatory agencies, industries, and research agencies is required to make progress.

General

Sewage and Disease

The survival of *Leptospira icterohaemorrhagia*, the causative organism of infectious jaundice, was studied by Chang, Buckingham and Taylor (71). The survival time in water varied from 12 hours to over 3 months, depending on the conditions. At higher temperatures the survival time was shorter. In the presence of other bacteria the survival time was shorter than in water without bacterial contamination. In sewage the survival of *Leptospira* was only 7 to 8 days. The addition of food substances in the presence of bacteria was harmful to the survival of *Leptospira*. Addition of 5 p.p.m. iodine (residual of 0.5 to 2.0 p.p.m.) destroyed the *Leptospira* completely in 5 minutes. Calcium hypochlorite also killed the *Leptospira* completely in 1 to 3 minutes with residuals of 0.5 to 0.3 p.p.m., respectively. It was concluded that *Leptospira* are less resistant to disinfec-

tants than most non-sporulating pathogenic bacteria.

The survival of ova and miracidia of *Schistosoma japonicum* in sewage treatment processes was studied by the investigators of the National Institute of Health (126) (182). Digestion at low temperatures required 2 to 3 months to render the ova non-viable. Sludge drying at 60° to 75° F. required 3 months to destroy the ova. When sludge was dried at 85° to 90° F. they became non-viable in 9 days. Intermittent sand filtration was effective against the ova, but was not efficient in checking the miracidia.

The problem of waste disposal from railroad passenger cars was discussed by Wolman and Clark (286).

Radioactive Substances

The contamination of water supplies by radioactive substances and possible methods of removal of contamination were discussed in a general way by Morris and Carrett (172). Pathogenicity of fungi were not changed by exposure to radioactive phosphorus, iodine, and high voltage X-rays according to Pearson, Hammer, Corrigan, and Hayden (194).

Bacteria and Their Activity

The oxidation of various aromatic compounds by fluorescent pseudomonads was studied by Stanier (244). He found that benzoate, benzaldehyde, benzyl alcohol and phenylactate, were good substrates for the development of many strains. Benzene toluene and xylene were not attacked.

Pure cultures of anaerobic thermophilic cellulose decomposing bacteria were isolated by McBee (159). The products formed from the fermentation of cellulose by these organisms were carbon dioxide, hydrogen, ethyl alcohol, formic, acetic, lactic and succinic acids and glycerol, which altogether account for 70 per cent of the cellulose fermented.

Characteristics and methods of cultivation of sulfate reducing bacteria were discussed by Starkey (246).

Toxicity

A method of studying the toxicity of industrial wastes was suggested by Heukelekian (110) based on the effect on the oxygen utilization rates as determined either by the manometric or dilution methods of oxygen utilization.

The toxic effect upon fish of certain chlorinated sewage effluents was attributed by Allen, Blezard and Wheatland (6) to the production of cyanogen chloride from the reaction between chlorine and cyanide or the cyanate found in gas house wastes.

Combined effects of various unfavorable factors on fish are emphasized by Bandt (43). Such combined effects may be found in low pH and high Fe, a high D.O. (40 p.p.m.) and a high pH produced as a result of photopepithesis.

Washburn (271) studied the toxicity of copper and zinc plating wastes and of carburizing solution to blue gills and bullheads. Alkali-chlorination treatment of electroplating wastes greatly reduced the toxicity.

Analytical Methods

Papers were reviewed last year which proposed methods whereby nitrification in the B.O.D. test was inhibited by pasteurization or acid treatment. This year Abbott (1) (2) proposed eliminating nitrification with methylene blue. Each dilution bottle was treated with 3 p.p.m. methylene blue before incubation, and the Rideal-Stewart modification of the Winkler test was used to overcome methylene blue interference in the final D.O. test. The author suggested the study of other dyes which might prove more advantageous.

The effect of temperature on the B.O.D. test was reported by Gotaas (100). Filtered domestic sewage was diluted with bicarbonate or phosphate

dilution water with and without sea water in varying proportions. The temperature coefficient θ for the range 15°–30° C. was found to be $1.0417^{(T-20)}$ instead of the common value of $1.047^{(T-20)}$. Below and above this range the coefficient was unreliable. Deoxygenation constants of 0.16 to 0.24 (average of 0.181) defined the initial stage of oxidation. Phosphate dilution water produced higher deoxygenation values than bicarbonate dilution water.

The Warburg respirometer was applied to sewage and industrial wastes by Caldwell and Langelier (65). The method is recommended for a B.O.D. test in treatment control and especially in research studies on sewage and industrial wastes. The 24-hour B.O.D. values at 25° C. were approximately equal to 75 per cent of the standard 5-day B.O.D. The deoxygenation constant (first stage) decreased when sewage was diluted. Nitrification or other phenomena which cause a change in the rate of oxidation may be observed by this direct B.O.D. method.

Variations in B.O.D. velocity constants of sewage dilutions were reported by Ruehhoft, Placak and Kachmar (216). Dilutions of 50 sewage samples in 500-ml. bottles were tested daily for B.O.D. and nitrite formation for 10 consecutive days under standardized conditions. The results corrected for nitrification gave deoxygenation constants of 0.04 to 0.29 with a mean of $0.148 \pm$, a standard deviation of 0.059. The lesser the dilution of sewage the greater was the first stage velocity constant. Nitrite formation occurred more frequently in the higher dilutions and often within a 3- to 5-day period but, if the dilution contained one or more per cent sewage, nitrification was usually delayed beyond the 5-day period.

Additional studies on the variations in the first stage deoxygenation constant by Ruehhoft, Placak and Ettinger (215) were performed on three different B.O.D. dilution waters. After correcting for nitrification the carbonaceous deoxygenation values were found to vary from 0.07 to 0.25, or a mean of about 0.18.

The above publications confirm the need of extreme care in interpreting B.O.D. values. It is more and more apparent that the rate of deoxygenation is not a constant but depends on the concentration and availability of the pollutants to microbial decomposition under the influence of a particular set of environmental factors. Settling or filtration of sewage, which increases the soluble or more available fraction, the presence of readily available organic matter of industrial origin, and the presence of organisms adapted to the decomposition of usually resistant matter will all tend to yield higher rates of B.O.D. Based on D.O. standards for fish propagation, the B.O.D. due to nitrification may be as important as the so-called carbonaceous demand.

By means of a dropping mercury electrode and calomel half-cell Moore *et al* (169) have tested a polarographic determination of dissolved oxygen in water and sewage. A potential of 0.6 volts was recommended for general use with the addition of a maximum suppressor in tests on water. No suppressor is necessary in sewage tests. For continuous observation a potential of 1.6 volts was recommended for normal oxygen tensions, since it obviates the necessity of a maximum suppressor.

Hood (118) discussed the value of oxidation-reduction potentials as applied to sewage plant operations.

Alkyl sulfides and disulfides were quantitatively determined by bromine oxidation in acid solution (236).

On the determination of hydrogen sulfide Nussberger (186) described a simple absorption train and means of measuring and scrubbing 2 to 10 liters of digester gas through acid cadmium acetate. The sulfide is titrated with 0.01 N iodine solution. The apparatus

can be assembled from ordinary laboratory supplies.

Riehl (210) summarized the methods of the Ohio Department of Health for determining some heavy metals and cyanides in sewage.

Copper in concentrations up to 4 p.p.m. may be determined by use of a photometer test of the stable color complex formed with "Cuprethol," an improved dithiocarbamate reagent (284). Except for a few ions, relatively large concentrations of cations give no objectionable interference due to turbidity or color complexes.

In the absence of silica and certain other interfering ions, 0 to 1 mg. of orthophosphate may be accurately determined by adding 5 ml. of 10 per cent molybdate solution to the acidified sample diluted to 50 ml. and determining the transmittance of the yellow moylbdiphosphoric acid color in a photometer with a 380 to 420 micron filter (57). The method is less sensitive than the "molybdenum blue" method, i.e., a wider range (0 to 25 p.p.m. as P) can be tested.

Sax (228) described a method having less personal error in determining soluble silica as the yellow molybdisilisic acid color complex by the use of a quartz spectrophotometer.

An improvement in the Kjeldahl determination of nitrogen without distillation (156) consists of the addition of zirconyl chloride before the neutralization and titration of the ammonia to eliminate interference due to the presence of phosphates.

Acid dichromate methods of the oxygen consumed value of sewage, which are roughly proportional to the 5-day B.O.D., were reported by Ingols and Murray (122) and Rhame (206). The methods differ somewhat in that Ingols and Murray correct for chlorides and use a 1-hour digestion period with selenium catalyst in an all glass reflux, while Rhame uses a 2-hour boiling period with evaporation.

Four amperometric titrations with sodium arsenite may be performed to determine separately the fractional part per million of free available chlorine, chloramine, chlorine dioxide, and chlorite in a water sample (103).

An amperometric titration of residual chlorine in sewage was developed at the Wallace and Tiernan laboratory in Belleville, N. J. (157) (158). Two possible reasons for the low results by the O-tolidine method as compared to the new method are the decomposition of organic chloramines on addition of the acid O-tolidine solution and the slowness of reaction between O-tolidine and some of the organic chloramines. The new method consists of treating a sample with a measured excess of a standard solution of phenylarsene oxide, followed immediately by potassium iodide. The pH is then decreased to 2.5 or less by the addition of hydrochloric acid. Finally, the unreacted phenylarsene oxide is titrated with standard iodine using starch or, preferably, a polarized electrode as the endpoint indicator.

Sedimentation

Kalinske (129) presents general information on the settling characteristics of various suspensions and applies these data to the design and operation of water and waste treatment equipment, particularly of the slurry pool and sludge blanket type. Certain approximate calculations indicate that it is a good practice to keep the ratio of lateral distance between effluent takeoffs to clear water depth below 4; and in large circular clarifiers with a peripheral takeoff, the depth of sludge level should not be less than $\frac{1}{7}$ the diameter of the clarifier.

Larson (141) describes a new water treatment plant featuring two-story sedimentation basins, a design which might be adapted to sewage treatment. Each rectangular basin, 112 ft. by 110 ft. by 15 ft. water depth, contains a false bottom 7 ft. below the water sur-

face and extending almost the entire length of the tank. Water enters the lower compartment at one end, flows the length of the basin and returns on the upper level. Design detention period is 2.5 hours. Sludge scrapers are provided on the lower floor only.

Perry (195) describes an upward flow and trap consisting essentially of a rectangular tank 20 ft. by 30 ft. by 25 ft. deep into which is set a frustum of an inverted pyramid 12 ft. deep. The influent enters the annular space between the sloping sides of the hopper and walls of the grit chamber to set up a rotary motion in one direction, and enters the hopper through baffled long narrow openings on the vertical centerline of each sloping face. The effluent leaves through two concrete troughs running across the top of the basin.

Jenkins (123) describes a number of large scale experiments on rectangular tanks treating various types of sewage and industrial wastes. He concludes that there is no evidence that high velocities through the tank disturb sludge already settled, and that small differences in temperature do not apparently affect the operation of the tank.

Several articles (238) (76) (24) (30) have appeared on design practices and standards which, while not adding to existing knowledge of the subject, are very convenient for reference purposes.

Chemical Treatment

Kalinske (128) describes pilot plant studies made at Daytona Beach, Fla., on the use of sludge resulting from water softening, consisting principally of calcium carbonate and magnesium hydroxide, together with a small amount of alum, for treating domestic sewage. B.O.D. reductions up to 80 per cent have been obtained in treatment units having a total detention time of 1 hour.

Biological Filters

Biological and Biochemical Factors

Tomlinson (255) reports on growth and distribution of film in filters. This article was previously published in *The Surveyor* and was abstracted in the review published in THIS JOURNAL, March, 1947.

Heukelekian (113) summarizes his four previous papers comparing the biochemical nature of standard and high rate filters. A review of the detailed papers was presented in the March, 1946 issue of THIS JOURNAL.

Edmondson and Goodrich (87) continued the work reported in 1943 with nitrification and recirculation in trickling filters. The claim made previously that the application of a nitrated effluent to a ponding filter causes the film accumulated to disintegrate rapidly, has been confirmed. There is also a marked improvement in the effluent produced by the bioaeration unit when working in cycle with the nitrifying filter.

Tomlinson and Jenkins (256) carried on laboratory and large scale experiments on the control of flies by the use of chemicals such as DDT and gammexane. The results showed that these chemicals can be used as selective insecticides for the *Anisopus* and *Psychoda* in filters without affecting the scouring forms. The chemicals were applied conveniently in solution form to the sewage feed to the filter over a period of 1 to 2 hours For the control of *Psychoda*, 5 lb. of DDT per acre was necessary. The effluent from a filter treated with 5 lb. of DDT per acre was distinctly toxic to trout.

Simpson (237) cautions against the use of DDT emulsions containing Triton X-100 in the control of filter fly larvae, since this emulsifying agent was found to be detrimental to filter slimes. He suggests the use of such emulsifying agents as Duponal and Nacconal as being safe. Studies showed the solvents kerosene and xylene and DDT itself to be without effect on the slimes.

Performances and Operation

A digest of the performance of biological filters at military camps is given in the report "Sewage Treatment at Military Installations—Summary and Conclusions" (179). A review of the original detailed report was published in the March, 1947 issue of THIS JOURNAL. Mohlman (166) and Hardenbergh (106) review high rate filter performance, much of which is based on data presented in the NRC report (179).

A comparison of B.O.D. removals by second stage filters employing no recirculation is given by Leibee and Smith (143). Data are presented to show that a so-called low rate filter system, when loaded to the extent of 1000 to 2000 lb. of B.O.D. per acre ft., gave final effluents with much higher B.O.D. values than high rate filter systems under similar loadings. No assessment of B.O.D. removal by primary filters was given, nor information on loadings actually applied to the secondary filters. The data presented for the low rate filter loaded in the high rate range were based on one installation and are too limited in scope for generalization.

Arnold (38) presents information obtained on two standard rate filters operating in parallel, one housed and one open, to show that low winter temperatures do not affect the efficiency of the filters even when the temperature of the open filter dropped to 36.6° F. These results are at variance with numerous other reports. The presence of over 2 p.p.m. of nitrates in the open filter effluent indicates the filter had not been operating near its limiting load. The presence of nitrates also indicates the filter had not been operating at low temperatures for a prolonged period, as nitrate forming bacteria do not proliferate at temperatures below 50° F.

The effect of methods of distribution of sewage was studied by Kehr and Ruehhoft (132) who found little difference in performance of two high rate filters operated in parallel when one was dosed by a "rain-like" spray and the other by a conventional rotary distributor. Lumb and Barnes (154) report on periodicity of dosing standard rate filters and conclude that intermittent dosing every 4 to 9 minutes gives best results. Their observations obviously do not apply to high rate filters where hydraulic conditions are entirely different.

Petty (196) reports improved filter efficiencies by addition of enough lime (120 to 240 p.p.m.) to convert the bicarbonates to carbonates in the settled sewage. Under summer conditions, the filter stood hydroxide alkalinities as high as 50 p.p.m. and yielded excellent results. Under winter conditions, a few parts per million of hydroxide alkalinity proved deleterious. No data were presented to show the B.O.D. reduction caused by sedimentation following lime treatment and the relief given the filter. The filter influent pH varied from 9.6 to 10.0 and dropped from 7.3 to 7.5 in passing through the filter.

Operation of a multiple filter installation for treating combined sewage and milk wastes at Marysville, Ohio is reported by Wittmer (283). The four filters may be operated in parallel as single stage filters or in series, giving two-stage treatment with facilities for alternation. Using two-stage filtration, somewhat better results were obtained when the sewage flow was alternated every few days. However, the B.O.D. loading was only 0.82 lb. per cu. yd. during the alternating test as against 0.98 lb. per cu. yd. on the straight series run.

Application to Special Problems

Oeming (187) describes a two-stage high rate filter installation employing a dual clarifier for the treatment of milk wastes. This installation is licensed under the Trebler patents.

Gehm (98) reports on the status of

trickling filters in the treatment of alkaline wastes produced in pulp and paper manufacture. Strawboard and rag mill wastes were found to be amenable to such treatment, but kraft and de-inking wastes were not. Attempts to increase the efficiency of B.O.D. removal were fruitless. The author concludes that until someone finds a way to increase the efficiency of trickling filters in the high loading ranges that filter installations will be too large and expensive for the industry.

Design

Two interesting and contrasting papers on methods of design were presented during the year. Greeley (101) describes the empirical method of design of high rate filters which is used by his firm. From basic operating data obtained at selected installations known to be of good design and well operated, curves are developed which show expected B.O.D. removals under various loadings and rates of recirculation. These curves provide data for determining workable and most economical units for each situation.

Velz (267) has deduced from the published results of various investigations that the removal of B.O.D. while passing through a filter follows the well-known biological oxidation law developed by Phelps, namely:

$$L_D/L = 10^{-kD},$$

wherein D (depth) replaces T (time) in the conventional expression. The values of k, the logarithmic rate of extraction, were found to be 0.1505 and 0.175, and the values for L, the removable B.O.D. fraction, were found to be 0.784 and 0.90 for high and low rate filters, respectively. No mention was made of nitrification as a factor which would influence the magnitude of these values. Considerable point is made of the effect of temperature on limiting loads, and a figure is presented to show the relationship. The effect of temperature as shown is based on the well-known temperature correction factor applied to long-term B.O.D. reactions, and neglects consideration of colloider action and changes in synthetic-oxidative relationships at various temperatures. The article is poorly documented and much is left to the reader to substantiate. Performance curves are developed for both types of filters using the values of k and L mentioned above, and examples are given of how they may be applied to design. A comparison of observed and computed performance for several plants included in the NRC report (179), the Walton report, and others, is given. The correlation, in general, is good.

Southgate (241) discusses British Standard Specifications for media for percolating filters, covering size, shape, durability, etc.

Activated Sludge

In a study of the mechanics of the activated sludge process, Abbott (3) used two methods of formulating the rate of change of organic matter in true and colloidal solutions when sewage is aerated with activated sludge. One method assumes that some deflocculation occurs through friction of gelatinous sludge particles against each other or against the walls of the aerator. This formulation is cumbersome and difficult to derive. The other method is a simple equation, monomolecular in type with a single coefficient, which measures the rate of decrease of the analytical constituents capable of removal under the conditions of the test.

Using strong latrine sewage, Abbott (4) found that, after removing all suspended solids by centrifuging, he could express purification of sewage by the activated sludge process as a linear equation.

In small scale laboratory experiments, Okun (189) has studied the use of pure oxygen in the activated sludge process. He found that, since the solu-

bility of pure oxygen at room temperature is about 45 p.p.m., the oxygen requirements of a sewage are satisfied at all points by preoxygenation. Its relatively high solubility permits the oxygen to penetrate more deeply into the floc particles. Separate final sedimentation tanks are not required. Using oxygen, the system could be loaded four times as heavily as with conventional activated sludge.

Pomeroy (200) reports that the efficiency of an aeration system is best measured by the pounds of oxygen dissolved per kilowatt hour under standard conditions, which are zero dissolved oxygen and 20° C. Results under actual conditions can be easily converted to the standard by computation. At Laguna Beach, Calif., 1.55 lb. of oxygen were dissolved for each kilowatt hour input to the motors.

Pillai, Wadhwani, Gurbaxani and Subrahmanyan (198), in a comparison of various bacteria and two protozoa, *Vorticella* and *Epistylis*, found that the protozoa were more active than the bacteria in the flocculation and oxidation of the organic matter in the sewage. They (197) also found that when sludge was inoculated with the protozoa *Epistylis*, the nitrogen content of the sludge increased during a 24-hour aeration period. Aeration with *Vorticella* and many strains of bacteria caused a reduction in the nitrogen content of the sludge.

The Manchester (England) Rivers Department (155) has compared the Haworth bioaeration, Simplex and diffused air systems of activated sludge. With about equal effluents, the data were as follows:

	Hours Aeration	Horse-Power per M. G.
Haworth bioaeration	16	40
Simplex	13	26
Diffused air	8	26

Figures for capital cost and plant maintenance would be needed for a more complete comparison.

Manchester experiments (155) also showed that when excess activated sludge is returned to the raw sewage, flocculation of the mixture either by air or mechanical means before sedimentation was effective in removing suspended solids and oxygen-absorbing materials.

Edmondson and Goodrich (86) reported that best results are obtained with the Haworth system of aeration when triangular paddle blades are used, and when the speed of rotation of the paddles is 30 r.p.m. The amount of oxygen dissolved also varies with the depth of paddle blade immersion.

Stanley and Berberich (245) have analyzed the operating data from 27 activated sludge plants, and by plotting four major factors against B.O.D. removal, they have found the relative magnitude of each factor to be in the following order: B.O.D. loading, aeration contact hours, solids concentration in the aeration tank, and air quantities supplied per gallon of sewage. Other factors, such as the chemical character and nutritional quality of the organic matter in the sewage, the temperature and the stage of nitrification, must be included before any real basis of design factors may be established.

Addition of digested sludge or supernatant liquor to aerators has been a procedure for several years at Ann Arbor (282) to maintain a proper balance between various constituents of the sludge. Witcher believes the supernatant should be added directly to the aerators as preliminary treatment does not seem to be beneficial.

According to Roe (212) the "Wide Band" principle of aeration depends on placing diffuser tubes at right angles to the tank side walls. In theory, larger volumes of liquid and air bubbles are continuously rising than when the same air is introduced in a narrow band. The precision tube consists of Saran plastic cord wound tightly and closely around a corrugated stainless steel core. It is said to be easy to clean,

to have low pressure loss and to be free from breakage during handling.

An ingenious method of sandblasting the underside of diffuser plates grouted into place has been described by Longley (153). End plates in a box were removed, and the sandblasting nozzle mounted on a metal boat was pulled back and forth below the plates. Most of the clogging was caused by a tight layer of black material covering the air side. Immediately after cleaning the top and bottom sides, the permeability of the plates nearly corresponded to that of new ones, but the pressure soon rose to 7.6 p.s.i. and remained there for some time. In two years it was necessary to reclean the plates. The cost of sandblasting only was 35.8 cents per plate.

Setter (233) has discussed the causes of plate clogging, types of air cleaning equipment and air diffusion problems at New York City plants. He believes that the trend toward coarse plates is not justified, and that higher rates of air flow per plate are desirable to prevent migration of aeration tank solids into the plate.

Using step aeration, the Bowery Bay (N.Y.C.) plant has treated 40 m.g.d. of sewage in 2.5-hour detention aeration tanks. Torpey (257) reported that an average sludge age of 3.5 days was maintained and that removal of 90 per cent of the B.O.D. applied to the secondary system and development of satisfactory sludge indices were attained with B.O.D. loadings of 55 to 84 lb. of B.O.D. per 1000 cu. ft. of aerator per day.

The use of step aeration seems to give promising results at the Kessener brush aeration plant at Rochdale (England) (21), and Niles (183) reported that step aeration is planned for the proposed activated sludge plant at Toledo.

Milling (163) reports that in the Baxter-Milling process, sewage enters the aeration tank through a slotted trough which extends along the length of one side of the tank. The settling compartment is an integral part of the aerator, separated by a sloping baffle wall. Liquor continuously passes to the settling compartment, clear liquor drawn off the top and the sludge is automatically returned at the bottom.

Herzik (108) presented data from eight contact aeration plants in Texas. These plants served populations of 500 to 44,300. Overall B.O.D. reductions varying from 71.8 to 94.3 per cent were obtained at different plants, based on composite samples. Air consumption varied from 1.0 to 4.6 cu. ft. per gal. of sewage, with an aeration period of 1.48 to 5.2 hours. These results are based on analyses made by the Texas State Department of Health.

Chlorination

Increasing attention is being devoted to the study of certain fundamental factors in sewage chlorination. Beyond its recognized use as a disinfectant, the applications of chlorine for the treatment of sewage and industrial wastes may be expected to expand in proportion to the amount of basic research on such factors. Chlorine is a valuable sanitation tool, and its special applications are by no means exhausted.

Logan (150) has delineated the rapid growth of the chlorine industry in the United States. While the annual production of chlorine has grown from 25,000 tons in 1909 to 1,400,000 tons in 1947, the sanitation uses of this product represent only about 3.5 per cent of the total production, or 10 per cent of the chlorine shipped for sale. The present shortage of chlorine is due largely to the development of new and the expansion of old industrial uses. A considerable proportion of chlorine use in sewage treatment is seasonal in nature; this fact presents a real supply problem to producers. Useful information relating to the safe handling of liquid chlorine is provided in another paper by Logan (149). This includes recommendations concerning the han-

dling of containers under normal circumstances and those which apply when emergencies arise. The various uses of chlorine in sewage treatment have been reviewed by Chamberlain (70).

The bactericidal action of chlorine is explained by Knox, Stumpf and Aurbach (138) by the inhibition of sulfhydryl enzymes and other enzymes sensitive to oxidation resulting in the death of the bacterial cell. Fair *et al.* (95), on the other hand, believe that the ability of the chlorine to enter through the cell wall, e.g., the rate of diffusion, determines largely the rate of disinfection. In the case of disinfection with chlorine, it is not the strong oxidizing power of HOCl that makes it a superior disinfectant, but rather its small molecular size and electrical neutrality.

Research in Chlorination

In presenting a statistical approach to sewage chlorination, Eliassen, Heller, and Krieger (90) have evaluated the effect of initial mixing on the bactericidal efficiency of chlorine. Using cotton-filtered sewage, it was shown that results which could be considered statistically significant were obtained by performing ten experiments on ten separate days, taking one portion from each experiment for bacteriological analysis. No important difference was found between results obtained with rapid or slow mixing. However, consistently lower M.P.N. values were obtained in chlorinated sewage which had been initially mixed than in sewage into which the chlorine solution was added without any subsequent mixing.

Heukelekian (111) has investigated some of the bacteriological aspects of hydrogen sulfide production from sewage. His results show the number of sulfate-reducing organisms in sewage to be low (60 to 600 per ml. in five sewages examined during cold weather), but that greater numbers are present in various sludges (25,000 per ml. in these studies). The number of sulfate-reducing organisms found in sewer growths was surprisingly small (6,000 per ml.); thus, it appears that bottom deposits in sewers rather than the floating growths, attached at one end to the sewer, are the seat of sulfate reduction activity. Subresidual chlorine treatment, sufficient to satisfy 60 per cent of the chlorine demand, is found effective in destroying these organisms.

Another investigation reported by Heukelekian (114) indicated that the elimination of hydrogen sulfide odors of sewage after they are produced by septic action required nearly ten times as much chlorine as would be required to prevent their formation. It is shown that 75 per cent of the demand must be satisfied in order to eliminate hydrogen sulfide, but that only 25 per cent satisfaction of the chlorine demand of sewage is required to prevent its formation.

The usual methods for determining chlorine residuals in sewage are known to have many shortcomings. A new amperometric method, presented by Marks, Joiner, and Strandskov (157), includes in the determination chlorinated compounds which are not measured by the usual methods. These compounds appear to exert considerable bactericidal action, particularly when only a portion of the chlorine demand is satisfied, as in chlorination to control septicity.

An analytical method published by Haller and Listek (103) enables the determination of active chlorine compounds in water. While this does not appear to be of immediate interest in chlorine treatment of sewage, a method which permits separate analyses to be made for free available chlorine, chloramine, chlorine dioxide, and chlorite may be applicable to the entire field of chlorination.

At the University of Florida, Kiker (134) reports that a research fellowship has been devoted to study of the reactions between chlorine and the simple amino acid, glycine. The reactions

of chlorine upon tryptophane are being studied at present, and those upon other amino acids will be the subject of investigations.

The unique pilot scale sewage treatment plant recently provided at the University of Florida (207) includes a chlorinator and a chlorine contact unit. In studies of disinfection, contact times ranging from 20 min. to 70 min. can be investigated for the treatment of effluents from various primary and secondary proceses, varying widely in chlorine demand. The influence of factors other than contact time are to be studied at this plant, according to Kiker (134).

Application of Chlorination

A high degree of sewage treatment is required during the summer season in a plant serving a small suburb of Milwaukee, according to Strand (250). This requirement has been accomplished economically by employing biological treatment, sand filters, and chlorination. The B.O.D. of the plant effluent normally is lower than that of the water in the receiving stream. During the summer, the B.O.D. of the effluent is reported to be 5 p.p.m. after sand filtration and chlorination, a reduction of 97.5 per cent.

On the basis of "sound engineering merit" the Allegheny County Sanitary Authority has recommended (31) a single central sewage treatment plant serving the entire area. Charges for treatment of sewage and industrial wastes are to be based on the solids, oxygen demand, and chlorine demand characteristics of the waste. Chlorination will be a requirement of the State Sanitary Water Board, and the chlorine demand of the effluent cannot be determined until the plant is in operation.

The only significant source of hydrogen sulfide in raw sewage at Winnipeg, Can., has been determined by Laidlaw (140) to be waste from packinghouse and abattoir operations. Since sulfides have had serious effects on concrete portions of the sewage plant, the effectiveness of chlorine in sulfide removal has been investigated. The removal of low concentrations (below 0.8 p.p.m.) appears to require chlorine in an amount 3 to 6 times that of the sulfide content, while the reduction of high concentrations of sulfide appears to require twice as much chlorine as sulfide. This report would be increased in value if it included data on the preventive use of chlorine, and on actual total chlorine requirements for treatment of sewage of varying sulfide concentrations—rather than relative demands based on sulfide-chlorine ratios.

A discussion of the application and results of chlorination is provided in a round table summary (23). This includes the evaluation of varied points of application, dosage requirements, and benefits derived from the treatment.

Chlorination for Disinfection

Chlorination of the entire sewage flow at Los Angeles continues, in conjunction with coarse screening, to constitute the treatment provided pending completion of biological treatment and more adequate sewer outfall facilities. This temporary treatment, required for the protection of bathing beach facilities, was described in detail in the review of 1947 literature. According to Schneider (230), the amount of chlorine required for disinfection continues to average 18 tons per day. In spite of this large consumption (which would warrant the use of chlorine in single unit tank cars) local conditions require the use of chlorine in ton containers, and a bank of six evaporators is provided to supply gaseous chlorine to the chlorinators.

Studies reported several years ago by Jensen and Jensen (124) have been extensively reviewed; they describe experiments on the sterilization with chlorine of sewage containing tubercle bacilli. In the experiments reported

by the authors, autoclaved sewage to which suitable numbers of tubercle bacilli were added was employed. The sewage was settled, filtered through paper, and diluted with tap water; its B.O.D. was equal to that of a biological filter effluent. Chlorine was added in the form of calcium hypochlorite solution, but the pH was kept at the neutral point. The application of 20 p.p.m. of chlorine appeared to kill all added bacteria (10,000 cultured tubercle bacilli per ml.) when tests were made on a culture medium, and a check with guinea pig inoculations confirmed the results of the culture tests.

Tubercle bacteria from sputum were considered more resistant than those obtained from cultures, and homogenized sputum (treated with 4 per cent NaOH to eliminate contaminating bacteria) was employed in subsequent tests. When the sewage contained 4000 tubercle bacilli from this source, it was sterilized by 9 p.p.m. added chlorine after one hour of contact. Since this test indicated no greater bacterial resistance, it was repeated using sputum without preliminary alkali treatment. The results were the same as in the preceding tests, and led to the conclusion that the resistance of cultivated and sputum tubercle bacilli is the same.

In a plant scale test of chlorination, the chlorine was applied automatically in proportion to sewage flow. Chlorination was applied following biological treatment (Imhoff tank and activated sludge) and ahead of a contact tank where the detention time varied from 3 hours minimum to 7 hours average. Samples of raw sewage constantly contained virulent tubercle bacilli, and their numbers were not appreciably reduced by activated sludge treatment. Under these conditions, completely effective kill of tubercle bacilli was reported when the chlorine dose was 10 p.p.m.

Tests by Melnick (161), in Chicago and New York City, provide evidence that virulent poliomyelitis virus may exist in raw sewage during epidemic periods. Swimming at polluted beaches was considered one of the factors implicated in a poliomyelitis epidemic at Key West, Fla., and chlorination of sewage was adopted shortly after the beginning of the epidemic. Davis and Silverstein (81) report the local water supply was considered a potential mode of transmission; accordingly, water was piped from another community and was chlorinated three or four times before use.

Chlorination in Industrial Waste Treatment

According to Ridenour (208), the alkali-chlorine treatment of metal plating wastes to remove cyanides and heavy metals is increasing in popularity because of economical and operating advantages. He reports results of laboratory studies concerning the effect of these wastes, after treatment, on the activated sludge process and on sludge digestion. The destruction of cyanides was found to be practically complete; that is, the cyanide content after treatment was less than 1 p.p.m. His results indicate that 16,000 lb. of treated waste could be tolerated per million gallons of sewage in the activated sludge process, if evenly distributed over a 24-hour period. The digestion units in such a process would be affected less than the aeration process.

The need for chlorination to enable the industrial uses of reclaimed sewage effluents is noted in a comprehensive review of these uses by Veatch (266). The highest degree of purification accomplished is probably that at Grand Canyon, Ariz., where activated sludge treatment is followed by coagulation, filtration, and disinfection with chlorine. At Big Spring, Texas, effluent from a municipal contact aeration plant is purchased by a petroleum refinery; the effluent is settled and is chlorinated for slime control. The largest use is that at Baltimore, Md.,

as described in detail by Wolman (285). A steel company purchases activated sludge effluent and uses it without further treatment except for continuous chlorination. The trickling filter effluent is coagulated with alum, settled and then is chlorinated. Slime control, in a long transmission main, is the primary reason for chlorine treatment at Baltimore, though algae control in a storage reservoir is reported to be a secondary accomplishment.

Chlorine Products in Sewage Treatment

Primary treatment, augmented with chemical precipitation, is the type of sewage treatment employed at Oklahoma City. Taylor (253) describes an extensive sewer cleaning program, necessitated by reduced sewer capacities, which required by-passing of sewage directly to the river. This resulted in a serious odor nuisance and three dosing stations were established to apply Cloroben. Routine dosage of about 2 p.p.m. (2 gal. per m.g. of sewage) proved sufficient to prevent hydrogen sulfide formation.

In describing sewer maintenance experience at Long Beach, Calif., Kennedy (133) reviews results obtained by the application of Cloroben. The upsewer application of this material, in continuous dosage, has provided acceptable control of dissolved sulfides for more than one year. Discussion of the Kennedy paper by Lemcke relates to studies of sulfide control since 1930 on the Orange County outfall force mains. Chlorine application was started in 1928 and is still in use. Ferrous sulfate, ferrous chloride, zinc sulfate, sodium nitrate, ozone, lime and Cloroben have been studied as control chemicals. Trichlorophenol has given fair experimental results, especially for masking odors, but is difficult to obtain. The best practice at present is found to be the use of compressed air in force mains, and the use of chlorine and/or lime in gravity flow sewers.

Sludge Digestion

Theory

Buswell and Sollo (62) are of the opinion that methane results from the fermentation of acetic acid by simple decarboxylation. Although not definitely proven their argument is logical and indicated by experiment.

Schnellen (231), in a doctorate dissertation, studied the mechanism of methane fermentation. He found that in addition to the acids and alcohols such as ethyl and butyl alcohols, acetic, butyric and propionic acids, which Barker had earlier found could be utilized by methane bacteria, propyl alcohol was converted to methane, and propionic acid and isopropyl alcohol to methane and acetone. The quantity of methane formed was equivalent to the quantity of carbon dioxide utilized from the medium. He further isolated an organism capable of fermenting methyl alcohol and another one fermenting sodium formate. Pure cultures of certain methane fermenting bacteria were able to convert carbon dioxide and hydrogen directly to methane. The anaerobic conversion of carbon monoxide and hydrogen to methane by pure cultures of methane bacteria was accomplished by Kluyver and Schnellen (137). However, it was shown that this fermentation proceeds in two steps, in the first of which carbon monoxide is converted to carbon dioxide which in the second step is reduced to methane.

Practice

The practical aspects of various phases of operating sludge digestion are ably discussed by various authorities on the subject as reported in THIS JOURNAL (35).

In a series of seven articles on digestion practice Van Kleeck (262) reviews and comments on the four available established methods used for the digestion of sludge, i.e., septic tanks, Imhoff tanks, unheated and heated separate

sludge digesters, and lagoons as supplemental units.

At one time lagooning was the most common method of sewage sludge disposal, and the use of lagoons is a form of separate unheated sludge digestion according to the report issued by the Committee on Sewage Disposal, Engineering Section of the American Public Health Association (193). This report deals with the use of lagoons in the United States and England and with the problems involved in such use.

Nottingham and Ludwig (184) describe the three essential functions of septic tanks which relate to detention period and storage capacity, and give test data obtained in order to determine the relationship of the shape of the tanks to their efficiency.

For small group communities Cahalan (64) describes how small welded Imhoff tanks may be used.

The description of the extension to the sludge digestion facilities at the North Toronto sewage treatment plant, and the operation experiences since 1935 when the extension was placed in operation, are given by Nevitt (181). The enlarged plant became overloaded despite the more generous allowance of capacity. The operation was changed from single stage to multistage.

Capacity and Design

The subject of digester design for small plants is well handled in a series of articles in *Public Works* discussing general factors to be considered in designing small plants (32).

Rankin (201) discusses various yardsticks used for determining digester capacity and points to the necessity of taking into account both the water content of a sludge and the nature of sludge solids. He argues that ample digester capacity is necessary to eliminate supernatant problems and that the sludge should be thickened before digestion.

Heating

Kunsch (139) reports on experiences with the external heat exchanger in the Urbana-Champaign Sanitary District, and concludes that this device answers problems involved in using interior hot water coils. Although the operating costs are somewhat higher they are evidently more than counterbalanced by the abnormally high destruction of volatile matter and gas production.

Heukelekian and Kaplovsky (112) present interesting data to show what effect temporary interruption in the heating facilities would have on thermophilic digestion when heating is subsequently renewed, and to determine if the organisms responsible for digestion at 40° C. (104° F.) are the same as those functioning at 50° C. (122° F.). Although the organisms operating at these temperatures are probably similar, those responsible for digestion at 20° C. (68° F.) are different. Thermophilic bacteria are evidently facultative rather than obligate. Temporary changes in temperature from the thermophilic to mesophilic range merely stop thermophilic activity, which is resumed when the sludge temperature is again elevated into the thermophilic range.

Schofield and Tark (232) disclose a novel flash heater for the digestion system to be installed at the Philadelphia Northeast Treatment Works. As a direct contact combustion heater it operates in temperature ranges far above the well-known steam jet heater, and is somewhat akin to Keefer's method (131) of heating sludge. The circulating sludge coming in contact with the heat transfer elements or products of combustion appears to reach ultra-thermophilic temperature ranges. The superheated products of combustion jet at high speed into the circulating cold raw mix at a temperature of about 2400° F. (1300° C.), and the waste gases escape from the heated sludge mix at better than pasteurizing temperatures (150°–180° F. or 66°–82° C.).

The hot sludge stored in the digestion tanks evidently stays well out of this temperature range.

Quite the opposite extreme of the foregoing method of rapid and efficient flash heating is depicted in three articles by Vaseen (263) (264) (265). This author reports on the same heating method previously described by Sphar (243) and critically handled in this review last year. This method relates to imbedding heating coils in the relatively nonconducting cement walls and floors of a digester in order to avoid equally non-conducting sludge scale deposits on coils submerged directly in the sludge. This heating method is adapted only to small tanks. However, even here efficient circulatory sludge turnover described in the above references (Kunsch, Schofield and Tark) is necessary. Furthermore, in the Vaseen installations, what will be the circulating water and wall temperatures in order to maintain the digester contents at the mesophilic temperature optimum of 95° and 100° F. which is common to most modern installations? Such temperatures with efficient sludge turnover and heat transfer during digestion reduce expensive digestion space and produce more gas. The author admits an additional heat exchanger will be necessary to supply enough heat in the coldest weather at Leadville, Colo.

What digesters will do with heating coils buried in sand was discovered at Ann Arbor (36). Here circulating water of 150° F. did not help matters.

At Ephrata, Wash., the digester is lined with Foamglass blocks in order to minimize heat losses (17).

Van Huben (261) relates how repairs on a broken heating coil in a small digester were undertaken. The problem of safely degassing the tank without available compressor is related.

Gas Production and Utilization

Walker (270) discusses the principles and factors governing methane production in sludge digesters, and its utilization. An excellent article on this subject was published in 1947 abroad by Poepel (199). This author deals with the digestion of various types of sludges with and without garbage, digestion space loading, temperature and material losses during digestion, and the participation of various organic materials in the production of gas.

Wirts (279) claims that the use of digester gas for augmenting public gas utility supply is unprofitable. These comments probably apply to plants like those in Cleveland, Ohio.

Instructive round table discussions and editorial comments on the storage and use of digestion gas are presented in *Sewage Works Engineering* (25) (77).

Industrial Waste

Buswell and Sollo (63) present an interesting report on laboratory experiments involving the anaerobic digestion of wood extract waste wherein a destruction of 90 per cent of the waste is indicated. Commercial design is also shown.

Backmeyer (41) discusses experiences with digesting cheese whey of high B.O.D. at Marion, Indiana. The author logically recommends the utilization of such whey by the dairy industry itself.

Toxic and Other Effects

Laboratory studies of the toxic effects of case hardening and zinc plating wastes on sludge digestion are presented by Ridenour (208). He concludes that with proper holding and distribution devices at the industrial plants the wastes will have little effect on digester operation.

Rawn and Candel (202) attempt to demonstrate that well-digested sludge may be diluted with primary clarifier effluent and discharged into fresh or salt waters where sludge banks will not be formed. The conclusions are that under such conditions this method of

disposal will be safe. Most of the conclusions are based on tests made in 2-liter bottles, and computation of the effect of recombining the digested sludge with primary effluent.

Utilization and Disposal of Sewage Sludge and Effluent

Sludge Disposal

Backmeyer (40) at Marion, Ind., reported further this year on current practices with liquid digested sludge disposal started in March, 1943. Truck delivery to farms within a 5-mile radius of the plant, and to lagoons, is now used. Spraying of garden lots and lawns has been discontinued, partly on health grounds and also no doubt because of nuisance conditions which may have arisen under certain circumstances. All deliveries are now made to farm fields that will not be planted in root type crops, and the trucks are dumped by gravity. Because of the grossly overloaded digesters at this plant, sludge must be hauled daily, necessitating the use of lagoon pits about 1 mile from the plant. These lagoons are used for about 67 per cent of the sludge produced, largely during periods when the farm fields are so wet that the trucks cannot make deliveries. When additional digester capacity is available and the removal of digested sludge can be controlled, a favorable cost as compared with vacuum filtration is believed possible. The vacuum filter has not been used since 1943. The Marion method of liquid sludge disposal, while apparently adaptable to this plant, would still appear to be of highly questionable advantage to the majority of sewage treatment plants in this country.

The disposal of liquid sludge as a fertilizer at certain Ontario municipalities is discussed by Roberton (211). A contractor is paid by the municipality for carting the sludge away, who in turn makes his own arrangements with the farmer to whom he delivers the sludge. The farmer must get a permit from the sanitary inspector of his municipality before the contractor can make delivery. There are definite regulations for the use of sludge as fertilizer. The quantity applied varies with the kind of soil and the crop. The fields should not be fertilized too frequently.

The Committee on Sewage Disposal of the American Public Health Association (193) reported on the use of sludge lagoons. While lagoons are generally considered as a temporary expedient for sludge disposal, a number of plants in Great Britain and the United States have successfully used them for a number of years. Recently, a renewed interest in lagoons is evidenced because of their low operating cost. Basically, lagooning may be compared to unheated separate sludge digestion, and the factors controlling good operating conditions with the latter will control lagooning with a minimum of nuisance. When receiving raw solids, it is well recognized that lagoons may be difficult to control in a northern climate, and may give rise to unpleasant odors, particularly in the late spring when the sludge temperature begins to rise above 60° F. and the sludge held through the winter starts to decompose. When receiving digested solids, lagoons become storage basins, and can be loaded over a period of years and then dried out and cleaned. Because of the economies effected, it is safe to predict that the use of lagoons will continue and even expand at plant locations sufficiently isolated.

Vacuum sludge filtration practices at Detroit, Mich., are reported by Burley (61). The sludge delivered to the filters may be raw, digested, or "mixed" sludge composed of raw and digested. It is the Detroit opinion that raw primary sludge filtration is the cheapest. This is at variance with the studies and results at many other plants. The reported return of digested sludge at Detroit to the sedimentation tanks for re-

settling would appear to be a form of elutriation. Winter troubles with raw sludge filtration are reported. The filtration practices cited follow standard operating procedures at other plants.

The results of experimental work with a semi-scale Dorr-Oliver vacuum filter for the dewatering of activated and other types of sludge at Davyhulme, Manchester, are presented by Wishart, Jepson and Klein (281). The filtration of activated sludge conditioned with ferric chloride gave a cake of moisture content of 87.9 per cent. The yield from the filter averaged 1.3 lb. of solids per sq. ft. per hour. The average dosage of ferric chloride was 12.7 per cent on dry solids basis. The high chemical dosages required and high moisture content compare unfavorably with the results obtained with activated sludge in this country. The filtration of mixed activated and primary sludges gave a cake of lower moisture content, depending on the relative proportions of the two sludges. The yield was higher and the chemical required was lower than with activated sludge alone. Aeration of sludges containing activated sludge for about 2 hours prior to conditioning reduced the amount of ferric chloride required. Sludges produced during dry weather periods were harder to filter. Elutriation greatly reduced the amount of ferric chloride, but was not as effective as aeration.

Oxidation Ponds

A report of the Committee on Sewage Disposal of the American Public Health Association under the chairmanship of Langdon Pearse (192) gives a review of the development, principles of design, operation and present status of oxidation ponds used in place of secondary treatment of sewage and for the treatment of industrial wastes.

Myers (173) gave the results of a study of various sewage lagoons in Texas. Their use is adapted for smaller communities, and where the climate permits year-around growth of algae. It is recommended that sewage be pretreated by primary settling, that lagoons be operated in series, that they be 3 to 6 ft. deep and that loading should be about 40 lb. B.O.D. per acre. Lagoons should have flexibility in operation. Temperature has a greater influence on lagoon operation than on sewage treatment plants. They have the merit of low construction and operation cost. The effluent can be used for irrigation of crops or fish farming. They may also be built to handle effluents from conventional plants.

The role of algae in lagoons was discussed by Espinosa (92). The generally accepted increase in D.O. due to photosynthetic activity of algae during daylight hours, and a decrease during the night, is confirmed for lagoon conditions.

Reclamation and Utilization of Sewage Effluents

A joint symposium was held under the auspices of the Federation of Sewage Works Associations and American Water Works Association on the reclamation of sewage effluents. Veatch (266) presented the results of a questionnaire sent to state sanitary engineers. The practice is limited primarily to arid sections for irrigation purposes. Only in nine instances were sewage effluents used for industrial purposes. A total of 135 localities practice sewage reclamation. Wolman (285) gave the details of the use of the treated effluent from the Baltimore plant by the Bethlehem Steel Co. for cooling of blast furnaces, open hearths, rolling mills, gas washers, wire machines, quenching, etc. Ten to 15 m.g.d. of activated sludge effluent is used after chlorination only. The 35 to 40 m.g.d. of trickling filter effluent is further treated by coagulation and settling.

The reclamation of sewage for irrigation purposes is discussed by Wilcox

(278). Analyses of sewage effluents are compared with those of irrigation waters. The salinity, sodium and boron contents are important considerations for water used for irrigation purposes. Effluent from domestic sewage is ordinarily safe for irrigation use from the chemical standpoint. Effluents containing trade wastes should be looked upon with suspicion, as they may contain materials toxic to plants.

Mechanical Equipment

In mechanical equipment for sewer construction an interesting advance in excavating machines is described by Esty (93). The machine is said to have "101 uses" in excavation. Another device that speeds work in sewer surveys is described in a staff article in *Engineering News-Record* (16). Mechanical aids in the maintenance of sewers mentioned in the literature include a report on a survey of by-passes made by the Interstate Sanitary Commission (26). Continued advances in the methods of maintaining and in increasing the efficiencies of pumps are described by Keefer (130) and, particularly for sludge pumps, by Daviss (82). Varied electric motor drives are described in a staff article in *Sewage Works Engineering* (22), and requirements for pumps, screens, and shredders are described in another staff article (24) in the same journal.

In the field of mechanical equipment for sewage treatment, vacuum filters have received considerable attention, being discussed by Nance (174), Burley (61), and by Wishart, Jepson, and Klein (281). Oil-water separators are discussed by Ross (213) and by Hoak (117). Equipment for warming the walls of sludge digesters is described by Vaseen (264); an external heat exchanger is described by Kunsch (139); and for the transportation of fresh sludge for distribution on land is described by Backmeyer (40). Van Kleeck (262), in a review of established methods for the digestion of sewage solids, describes necessary mechanical equipment and accessories therefor. Sand blasting equipment for the cleaning of diffuser plates is described by Longley (153).

A survey of mechanical equipment in sewage treatment works is reported by Babbitt (39), and the customary exhaustive survey of recent equipment offered by manufacturers appears in THIS JOURNAL (34). It represents probably the most fruitful source of information on recent developments.

Industrial Wastes

Pulp and Paper

The major portion of research reported on pulp and paper mill wastes during 1948 consisted of white water clarification together with associated problems and with biological oxidation of pulping wastes. The bulk of the work on white water treatment consisted of laboratory, pilot and full-scale clarification tests employing sedimentation, coagulation, flotation and filtration.

Both Calise (66) and Kahn (127) report on results obtained on board mill white waters employing "sludge blanket" type clarifiers, the former stressing recovery of solids in the manufacturing process to the extent of 97 per cent and the latter reporting 94 per cent removal of suspended solids and 59 per cent of the B.O.D. when alum or alum and activated silica were employed as coagulants. Sludge discharged from these units was found to average 1 per cent consistency, but external thickening could in some cases raise this figure to as high as 7 per cent. In discussing a flotation unit Hutchinson (121) states that the high removals of fiber by these devices is reflected in relatively high B.O.D. reductions, and that the sludge consistencies of 2 to 3 per cent obtained can be returned to the machine system. Coltart (78) presents detailed results on the operation of a rectangular mechanically cleaned

clarifier on paper mill white water. Employing alum as a coagulant, effluents containing on an average 40 p.p.m. of suspended solids and 14 p.p.m. of B.O.D. were obtained, representing reductions of 92 and 90 per cent, respectively. Examples of various clarification systems for white waters were presented by Sheen (234) together with recommendations regarding their incorporation in mill water systems.

Rudolfs and Axe (217) (218), summarizing quality variations of paperboard mill waste, concluded after a survey of eight mills that 10,000 gal. of effluent (on the average) were discharged per ton of product, containing 43.5 lb. of suspended matter, 106.5 lb. of dissolved solids and 31 lb. of B.O.D. Ninety-one per cent of the suspended solids settled readily, yielding a B.O.D. reduction of 40 per cent. Included in this presentation were data on the B.O.D. of various types of pulp, and considerable discussion of the relative oxygen demands of suspended and dissolved matter in such waste waters. These same authors (219) (220) presented laboratory results on treatment of white waters by means of flocculation, settling, and diatomite filtration. Pre-flocculation of boardmill and jute pulping mill white waters was found to be of doubtful value. Most of the common coagulants were effective, and activated silica was capable of reducing coagulant demand markedly. Sludge volumes obtained by plain settling were lower than those produced by chemical coagulation. Pressure and vacuum diatomite filtration of board mill waste, employing different filter aids, revealed that the removal of suspended solids varied with the waste itself, generally with the amount of filter aid used, and inversely with the rate of flow and the particle size of the filter aid. Generally, in excess of 95 per cent of suspended solids removals were observed, and optimum pressures for maximum yields varied with the nature rather than the concentration of suspended matter in the waste. The possibility of incorporating spent filter aid in the papermaking process was suggested.

Extensive diatomite filtration studies on board mill waste are reported by Halversen (104), which included both laboratory and pilot plant filter units of both pressure and precoat vacuum types. It was concluded that at 60 lb. pressure filtration cycles of 3 to 8 hours could be obtained with filtrate yields of 30 gal. per sq. ft. of area and filter aid dosage of 4 to 16 lb. per 1000 gallons. Extremely clear filtrates, low in bacteria, were consistently obtainable.

Considerable exploratory research on methods for concentrating tissue and other white water sludges was conducted by Rudolfs and Palladino (221) (212) (223) (224). Tissue sludges concentrated at very low rates depended mainly on initial solids content. Greater subsidence velocities occurred at higher temperatures, and sludge volumes readily decreased by settling or flotation in 3 to 6 hours to maximum density. Flotation was found to be a more effective means of compacting than settling. Alum was found to be a more effective conditioning agent than lime for board mill sludges prior to vacuum filtration, which yielded cakes containing about 70 per cent moisture. Lime was more effective for conditioning tissue sludge than diatomaceous filter aids, although the latter would be more applicable where re-use was contemplated.

Pilot plant studies (175) on the clarification of white water mixed with pulp tail washings employing flocculation and settling with and without chemical treatment showed that good clarification and a dewaterable sludge could be obtained by plain settling, pre-flocculating proving of little value. The application of chemicals even in high dosages in the presence of the pulping waste improved clarification but little, and produced a thin sludge resistant to dewatering.

A review of the application of trickling filters to a number of alkaline pulping wastes was made by Gehm (98) (99) (176). It was concluded from the data accumulated on these wastes that most of them could be purified to a fairly high degree with the exception of kraft mill waste. However, at the filter loadings obtained, enormous filter areas would be required for mills of the usual size, and it appears necessary that some entirely novel means of stimulating oxidation be found if this device is to be generally applicable. Sheen (234) presents data on trickling filter pilot plant experiments on rag pulping waste, which included B.O.D. reduction figures at varied filter loadings. Morgan (171) (177) described the laboratory and pilot plant development of a process capable of removing the bulk of solids and B.O.D. from de-inking waste. This consists of a modification of the activated sludge process employing an excess of air to prevent difficulties arising from the rather strong raw waste. Filter materials present in the waste produce a very rapidly settling secondary sludge, the rapid return of which enhances the process. Logan and Heukelekian (151) applied aerobic oxidation to sulfite waste liquor in both the liquid and foam phases. Liquid phase treatment in the presence of dispersed seed and high oxygen content atmospheres gave but 30 to 35 per cent B.O.D. reduction in 24 hours. Foam phase oxidation yielded B.O.D. removals of as high as 85 per cent in 24 hours.

Anaerobic digestion studies on strawboard and insulating board mill waste were reported by Bloodgood and Hargleroad (54) (178) and Buswell and Sollo (63), respectively. Laboratory tests showed that strawboard waste could be reduced 85 per cent in B.O.D. in 24 hours at a temperature of 37.5° C. Greater detention time was required at lower temperatures and lower ultimate reductions in B.O.D. were recorded. Similar tests applied to insulating board mill waste demonstrated B.O.D. removals of 90 per cent, employing two-stage digestion. On the basis of this process a system of treatment was proposed for a mill making this product.

Moggio (164) discussed data obtained from storage experiments on kraft mill waste in which variables were introduced for the purpose of determining the factors responsible for oxidation under these conditions. The same author (165) presented a summary of results on comparative B.O.D. methods as applied to kraft mill waste. A similar project was reported by Tyler and Gunter (259) for sulfite waste liquor in which modifications of the present B.O.D. test are suggested.

Lewis (146), Benson (49) and Pearl (191) reviewed progress in the production of by-products from sulfite waste liquor and outlined chemical possibilities of the major constituents. Hiester, McCarthy and Benson (115) described the separation of pure lignin sulfuric acids from the liquor. Daniels and McCarthy (80) and Leonard, Peterson and Johnson (144) reported on the production of butyric and lactic acids, respectively, by the fermentation of sulfite liquor, and fodder yeast propagation by a novel method is reported by Tyler and Maske (258).

Application of modern methods for evaluating a pollution problem in a given area was illustrated in a paper by Morgan (170). Field studies on the effect of kraft mill wastes on the aquatic environment by Van Horn (260) concluded that normal mill operation did not produce toxic levels in receiving waters. Raw kraft mill black liquor was found by Chipman (73) to depress the rate of pumpage of water through the gills of oysters and to decrease the period that the oysters remain open. The substance responsible for the effect was found to be present in the soap fraction of the liquor, which is now recovered by kraft mills.

Dairy Wastes

Bloodgood and Canham (52) discussed the methods of estimating the milk losses from a plant. Calculations from a small dairy products plant indicated that the losses amount to between 5.9 and 24.1 per cent of the milk received during any one day. The higher losses are influenced by the discharge of strong wastes such as whey, which would raise the equivalent milk solids appreciably. The same author (53) reviewed milk waste disposal by septic tanks and sand filters, low and high rate trickling filters, the Guggenheim process, and activated sludge, and concluded that there is no one entirely suitable process, although the wastes can be treated if the plants are designed with suitable capacity.

The design and operation features of a plant treating condensery waste at Ovid, Mich., are given by Oeming (187). The principal units include dual primary and secondary clarifiers, primary and secondary filters, and a digester.

The problem of whey disposal is reviewed by Sanders (226). The important considerations in this respect are a market for the whey solids, and simple and economical means of processing the whey. Neither of these requirements have been fulfilled up to the present time. Digestion, as a means of disposal of whey, is considered satisfactory by Backmeyer (41) as a temporary solution, although he also considers the utilization of the whey to be a more logical solution. The whey is transferred in tank trucks to the sewage plant and pumped directly to sludge digestion tanks. The effect of whey on the operation of the activated sludge plant at Marion, Ind., is also reported by Backmeyer (42).

Cannery Wastes

Hert (107) describes the operation of a small trickling filter sewage treatment plant handling large volumes of tomato and pumpkin cannery wastes. During the tomato canning season the population equivalent (B.O.D. basis) of the wastes was 6000 and the population of the town 1000. Trickling filter loadings of tomato waste at 0.71 lb. B.O.D. per cu. yd. gave 70 per cent removal, while a pumpkin waste loading of 1.3 lb. B.O.D. per cu. yd. removed 74 per cent. In a laboratory study of the chemical treatment of tomato canning wastes, Levine (145) shows that high calcium hydrated lime alone is better and more efficient than any of the usual chemical coagulants. Lime dosages of 4 lb. per 1000 gal. gave 99 per cent solids and 25 per cent B.O.D. removal. Sludge volumes, however, amounted to 15 to 20 per cent, and the sludge was not readily dewatered by vacuum filtration.

The experimental drying of tomato waste solids on a semi-plant scale basis is described by Templeton (254). Plant operation and costs are given and the author concludes that tomato waste dehydration can be economically successful if viewed from the standpoint of waste disposal, and not as a profit making process.

Disposal of canning plant wastes by irrigation in Iowa is discussed by Bolton (56). It is recommended that one acre be provided for 100,000 to 150,000 gal. of corn waste per day. The volume loading is considered to be the controlling factor rather than the strength or solids content of the waste. The Iowa Department of Health recommends their use.

With adequate pretreatment provided at the canning plant, a sewage treatment plant of adequate design and properly operated can successfully treat canning plant wastes according to Miller (162). Siebert and Allison (235) recommend fine screening, sedimentation, and lagooning as possible methods of treatment of cannery wastes. Nelson (180) also discussed the different methods of treatment for cannery wastes. The use of screens, vacuum flotation, trickling filters and predigestion is emphasized.

Beet Sugar Wastes

Brandon (59) reported on the re-use of beet sugar process water in the operation of a small scale diffusion battery, and concludes that process water reuse had no adverse effect on the juice quality and that the pulp was more readily pressed. Brandon (58) also shows the character of beet sugar manufacturing wastes with and without process water recirculation. Various experiments were made with biological and chemical treatment of the wastes, and the author concludes that where a high degree of treatment is required, lagooning of re-used water, followed by biological filtration, over a year's time would be economically advantageous. Allen *et al.* (7) and (8) show the types of organisms and the effect of chlorine treatment on re-used beet sugar diffuser water.

Brewery and Yeast Manufacture

A description of the operation of a spray drying process for "distillers solubles" is given by Ridgeway (209). Thin stillage after pressing is concentrated in multiple effect evaporators to 20 to 30 per cent solids. The concentrated liquor is sprayed at 2000 lb. pressure through a nozzle and rotating whizzer into the drying chamber, which utilizes boiler flue gas at 450° F. to reduce the moisture to 3 per cent. Such problems as nozzle size and wear, temperature control, fly ash removal, and product quality control are discussed.

Klassen and Troemper (136) summarize the usual whiskey distillery operations and the present practice of the industry in by-product animal feed recovery. Figures are given to show general heat requirements for the various evaporation and drying operations. They conclude that the complete recovery of whiskey stillage is not only practical, but also economically desirable, and that an over all efficiency of 97 per cent B.O.D. reduction is entirely possible. The remaining population equivalent is still approximately 1000 per 1000 bushels of grain handled.

At a meeting in Milwaukee in October, 1948, various papers on the recovery of brewer's yeasts were presented. This was also discussed by Mohlman (167). Grain recovery should always be practiced and yeast wastes frequently yield profits when recovered as feeds or sources of vitamin-rich concentrates. Hall (102) concludes that the press liquor solids of spent hops and spent grain contains 35 per cent protein. They do have value as stock feed if recovered. Yeast production is also possible and a reduction of 67 per cent in soluble B.O.D. is indicated. He also found that the bitter taste of spent hops can be removed with alcohol or other extractions to make them more palatable as stock food. Savings in fresh hops requirements and decreased hops waste are also indicated by the re-use of debitterized hops.

Tatlock (252) describes the operation of the Standard Brands yeast waste treatment plant at Pekin, Illinois. This plant, using three-stage digestion followed by a recirculating trickling filter, is operated by the "Controlled Digestion" principle, using volatile acid accumulation as a control of the digestion process.

The first of a series of papers on treatment of waste from compressed yeast manufacture is given by Rudolfs and Trubnick (225). The physical and chemical characteristics of such waste are shown and the authors point out that the waste and problems involved in treatment are different from those of the distilling industry, where yeast is a by-product and part of the waste.

Gelatine Manufacture

Bolde (55) reports the successful recarbonation of gelatine manufacturing wastes with flue gas to reduce caustic lime alkalinity so that the wastes will be acceptable for discharge into a public sewer system. The precipitated cal-

cium carbonate is removed in a secondary settling tank following recarbonation.

Coal Washing and Mine Drainage

Coal washing wastes are coagulated with sodium pectate alone or in conjunction with alum. Clark (74) reports that a substantially clear effluent, suitable for re-use, is obtained with less than 5 p.p.m. of sodium pectate and 50 p.p.m. alum.

British practice for the treatment of coal washing wastes is given in a report (277) of the West Riding of Yorkshire Rivers Board. Various types of treatment and equipment used are discussed. One interesting feature is the use of a well-point system to dewater precipitated coal and dirt slurries so that they can be handled by crane buckets and subsequently used as fuel. A rather comprehensive study of acid mine wastes from the anthracite region of Pennsylvania is reported by Felegy (97). Data from over 400 samples show acidities and alkalinities at various seasons of the year and stages of the Susquehanna, Lehigh, Schuylkill, and Lackawanna Rivers. The authors observe that although many small streams are initially acid, the mine drainage apparently has a beneficial effect on the rivers by neutralizing the alkaline sewage and industrial wastes being discharged into the rivers.

Flax Retting

A report on the relatively new method of aerobic flax retting, including descriptions of the anaerobic retting process and wastes produced, is given by the British Department of Scientific and Industrial Research (272). Aerobic retting of flax is accomplished in retting tanks equipped with air diffusers in the bottom. Air requirements are nominal and not continuous. The water is re-used many times with no impairment of efficiency and with only a five-fold increase in B.O.D. with 40 successive rets.

Cranberry Canning

Logan and Levine (152) discuss lime treatment of cranberry canning wastes. Addition of 2.5 lb. of lime per 1000 gal. will result in complete clarification, while 10 lb. and 50 lb. dosage will remove 16 and 25 per cent of the B.O.D. respectively. The waste initially has a B.O.D. of 4500 p.p.m. due mainly to sugar.

Starch and Coffee Processing

Eskew (91) reports on the recovery of pulp from white potato starch manufacture. A pilot plant is now under construction to develop an improved process of recovery. The study is being made primarily from the standpoint of pulp recovery and no mention is made of any proposed study of the wastes from the process.

Pilot plant treatment of coffee mill processing wastes on a recirculating filter were studied by Horton (120). For batch operation a loading of 3.7 lb. B.O.D. per cu. yd. per day gave 73 per cent reduction of a 2200 p.p.m. B.O.D. combined waste, while 1.2 lb. B.O.D. per cu. yd. per day loading gave 88 per cent reduction. Recirculation was at the rate of 20 m.g.a.d. and amounted to 5 cycles per hour.

Pharmaceutical Wastes Incineration

The operation of a dual hearth incinerator is described by Clift (75). This incinerator is designed to burn dry trash, animal manure, and filtered sewage sludge for a large pharmaceutical plant. Wet materials are dried by combustion gases in an upper hearth and burned with the dry materials in the lower hearth. Successful operation at 150 per cent of rated capacity is reported.

Packinghouse

Sanders (227) described a chemical process for packinghouse wastes. Primary treatment was followed by precipitation using sulfuric acid and ferric

sulfate at a pH of 4.8 to 5.2. On the average 200 p.p.m. sulfuric acid and 20 p.p.m. ferric iron are needed. Sludge is heated with open steam to 200° F., filtered and dried, with the product used for feed. It contains 30 per cent protein and 25 per cent ether extract and is suitable as an ingredient of mixed feed if below 3 per cent of the total. The process removed 60 to 88 per cent of the B.O.D. (effluent 130 to 480 p.p.m.), which could be lowered to 50 to 80 p.p.m. on a trickling filter at 2000 lb. per acre foot. The process is in use only at a small plant in the southern states, and has not been used in any large plant.

In England, Jones (125) gave results from a survey of a small slaughterhouse, discussing the various unit equivalents of the analyses. The unit losses were much lower than American losses, as discussed by Mohlman (168).

In Switzerland, Benoit (48) described a small plant for producing feed containing 55 per cent protein and 23 per cent fat, by autoclaving slaughterhouse wastes at 145° C. and 10 atmospheres, drying and preparing for sale.

Mohlman (167) discussed packinghouse wastes, giving unit losses, salvage operations and total effect of the B.O.D. of such wastes in the U. S.

Steffen (248) discussed paunch wastes, listing the various methods that have been used to recover the solids. However, most of the contents still go down the sewer.

Chemicals

Organic chemical wastes were discussed by King (135). The quality of effluents should be judged by the conditions of disposal.

Factors involved in abatement of waste disposal were discussed in a manual (275) published by the Manufacturing Chemists Association of the U. S. These ideas were discussed by Hess (109), Chairman of the MCA Committee on Waste Disposal, at the Detroit meeting of the Federation.

Wastes from rayon manufacture were discussed by Scheurer (229). The Front Royal, Va., plant discharges sulfide, alkaline and acid wastes. Neutralization of acid wastes is the main problem. Trickling filters are used for sulfide wastes. This plant has been ordered by the Virginia Water Control Board to construct additional treatment facilities (20).

Incineration (13) for small volumes of strong wastes was adopted by Hoffman-La Roche, manufacturer of synthetic vitamins, pharmaceuticals and specialties. Control of odors has been a problem at a similar incineration plant of the Lederle Laboratories at Pearl River, N. Y.

By-Products Coke

Nussbaumer (185) described an experimental biological filter for treatment of ammonia-still wastes at the Donner-Hanna plant in Buffalo. Results of operation are not yet available.

Southgate (240) summarizes extensive British experience in disposing of gas and coke wastes. There the Liquor Effluents and Ammonia Committee recommended that ammonia should always be recovered, higher acids and thiocyanates reduced as far as possible by modifying the process, and the effluent discharged to the sewer at as uniform a rate as possible.

Oil Refineries

The world's largest API skimming basin is being installed by Standard Oil of Indiana, to comply with requirements of a Master appointed by the U. S. Supreme Court (69).

A similar smaller separator (214) was installed at its Toledo plant by the Standard Oil Company of Ohio.

Eldridge (88) discussed disposal of waste soluble oils. Calcium chloride and lime plus ferric sulfate are used to separate the oil.

Iron Pickling

The Wheatland Steel Products Co. has installed a recovery process (14) at Wheatland, Pa., which cost $500,000. The waste pickle liquor is treated with zinc oxide, from galvanizing wastes, and chlorine is added. The slurry, consisting of ferric hydroxide suspended in a solution of zinc sulfate and chloride, is filtered and the filter cake dried. The ferric hydroxide is valuable as a pigment. Zinc salts are crystallized out and sold for lithopone manufacture or as a wood preservative. It has not been determined whether the process is profitable.

Pickle liquor neutralization (116) by alkaline agents has been discussed by Hoak. Lime, dolomite, acetylene sludge and cement dust were studied. A pilot plant was constructed at Devault, Pa., where the various agents have been tested. Operating results are not yet available.

Textile

Southgate (239) indicates that aeration is helpful in the handling of waters prior to re-use in the retting of flax. Scheurer (29) tells how the American Viscose Corporation mixes the domestic sewage, sodium sulfide waste, alkaline waste, and acid waste from their plant manufacturing rayon, neutralizing the mixture with lime, and filtering on a vacuum filter. Supernatant waters and filtrate are discharged to retention basins (3 m.g.) from which the waters flow directly to the Shenandoah River. Besselievre (50) recommends the use of lime in the treatment of textile wastes. Barkholt (44) gives a general discussion, with illustration, of the prevention of pollution and the recovery of chemicals from the viscose process.

Wool Scouring

A description (15) of the handling of the wool scouring wastes in Bradford, Yorkshire, England, states that the grease is precipitated with the sewage sludge by sulfuric acid, following a procedure adopted many years ago. After treatment to remove detritus, the sewage passes to precipitation tanks where the acid is added. The effluent from these tanks is oxidized on biological filters. The filter medium is hard Yorkshire coal. Sludge from the precipitation is dewatered in plate and frame presses and the cakes are allowed to mature so that bacterial action reduces the grease content before the residue is ground and sold as fertilizer. Some grease is separated from the filter effluent by flotation, and is clarified and eventually sold to distilleries. Briedham (60) also discusses the Bradford plant, and indicates the need for reconstruction of the biological filters. A suggestion is made that the daily flow be "balanced" so that continuous working of the filters can be maintained. The grease recovered has a high value and the revenue largely offsets the total cost of the works. The effluent from the sedimentation tanks is difficult to handle on biological filters and is very corrosive because of the 3.5 pH.

In England (33) it has been found that synthetic detergents used in wool scouring will make the resulting wastes more difficult to treat. The quantity of recovered grease is smaller when these detergents are used. Campanella (68) reports that the foreign matter in wool scour water can be precipitated with $Ca(OCl)_2$. The precipitate is in curd form and is separated by skimming into light and heavy fractions, each of which is treated to recover its grease content.

Tannery

Reuning (204) (205) gives the characteristics of vegetable tanning wastes and then proceeds to discuss screening, primary sedimentation, and sludge disposal as they pertain to the treatment of this particular waste. Screening is advisable as a protection to equipment. Primary sedimentation may be done in

earthen basins, or concrete, wood, or steel tanks operated on either "flowing through" or "fill-and-draw" principle. The sludge may be disposed of in large storage lagoons or on shallow drying beds. Centrifugal dewatering of the sludge can be used, but it is a rather expensive way of reducing the sludge volume 80 to 90 per cent. Spent tanning liquors are evaporated for recovery of soluble by-products.

Metal Plating

Wise (280) discusses the origin, nature and volume of electroplating wastes. He states that there are two methods of treating these wastes in use in Connecticut: (a) precipitation with ferrous sulfate and lime when the chromium content is less than 200 p.p.m., and (b) precipitation with barium sulfide and lime when more concentrated solutions are experienced. The treatment is carried out on a batch basis or in lagoons.

Lockett and Griffiths (148) found from laboratory tests that cyanide interfered with the decomposition of sewage. Their tests with cyanide in activated sludge also showed a marked inhibitory effect on the process.

Fales (96) outlines the waste disposal problem of a plant producing parts for aircraft engines. His suggested methods for disposal are: (a) storage of the combined wastes at times when standing baths are dropped, and uniform discharge of the stored wastes into the rinse waters during at least one shift; chemical treatment of the combined wastes throughout the 24 hours, with discharge of the effluent into the brook and dewatering of the sludge for disposal in a solid form, (b) collection of the standing baths when ready to be dropped by means of tank trucks, and transporting to tanks for chemical treatment to remove objectionable constituents, with discharge of the rinse waters to the river with no treatment except provision for chlorination to oxidize cyanides if they should be present in an objectionable amount.

In the "Report of Water Pollution Research Board" (273) it is stated that in the treatment of waste waters containing cyanide the use of ferrous sulfate and lime is being superseded by the chlorine and alkali process. Ridenour (208) reports laboratory studies on the toxicity of metal plating wastes to activated sludge and sludge digestion processes. The data presented would indicate that alkali-chlorine treated wastes are toxic, if concentrations are high enough, but a relatively high concentration is tolerable in the sewage before the efficiency of sewage treatment processes is seriously impaired. Washburn (271) in his studies on toxicity to fish of metal plating wastes after the alkali-chlorination treatment, found that certain copper plating solutions were 625 times less toxic to certain fish than was the untreated waste. Besselievre (50) recommends the use of lime in the treatment of chromium plating wastes.

Barnes (45) gives in considerable detail the design of a treatment plant to treat the plating wastes from the Talon, Inc., plant at Meadville, Pa. Chester (72) points out the importance of mineral-free waters in improving plating room operation. Such waters may be prepared from treated plating room wastes. McCormick (160) gives a method for protecting receiving streams from heavy "shots" of waste plating solutions. The studies of Bloodgood and Losson (51) show some promise that cyanide and chromium solutions may be treated with ion exchangers. Dobson (83) states that the application of chlorine for the oxidation of the highly toxic cyanide radical to form cyanates or carbon dioxide and various oxides of nitrogen is now a proved process, having been verified by extensive laboratory tests and several plant installations.

Stream Pollution

In discussing stream pollution abatement Weston (276) pointed out that the industrialist has a golden opportunity to perform a public service and obtain the goodwill of the public, and at the same time help himself by working seriously for abatement. He suggests that besides the hygienic, economic, aesthetic, and legal considerations, pollution may involve another consideration, i.e., that of industrial public relations. The paper includes discussion of the various effects of pollution, the losses through litigation and the political aspects. Anable and Kite (9), on the other hand, consider that the legislative aspect of pollution abatement is the most important consideration for coordinating the technical and financial activities of industry in the long range attack on this problem. They suggest that industry can never have any incentive or other reason for reducing pollution except to meet the standard required by the pollution control agencies in the area directly covered. Their viewpoint gives no consideration to the aspect of public relations or goodwill as an incentive for pollution control, and seems to justify the view held by some that more stringent legislation is needed.

A model sanitation code designed to aid communities in abating and controlling water pollution problems was developed by the Special Committee on Pollution Abatement of the Joint Legislative Committee of New York, and sent to officials of New York State cities, towns, and villages (28). This model code has seven sections which: (1) require sewer connections, (2) prohibit pollution of ground and waters, (3) define conditions of installation of septic tanks and the disposal of tank effluents, (4) define conditions for additions to disposal systems, (5) prohibit the disposal of refuse in an unsanitary manner, and (6) provide fines and penalties for violations of the provisions and requirements. A bill was introduced in the New York State Legislature to create a Water Pollution Control Board in the State Board of Health with authority to deal with pollution problems (29).

It was pointed out editorially (19) that before most industries in the Potomac River basin install additional processing equipment, the possible effect of the new installations on the pollution of the stream must be reported to top officials of the company. The manner in which industry in this area has shouldered its pollution abatement responsibilities not only reflects to the credit of industrial management, but also indicates the effectiveness of the youthful Interstate Commission on the Potomac Basin as an interstate pollution control agency. In West Virginia, Watson (274) described a long-range program to abate and control stream pollution which has for its immediate objectives: (1) stream classification of all waters in the state into one of four water quality zones, (2) cooperative improvement of industrial stream pollution, and (3) education and municipal planning toward sewage treatment. Although only 10.4 per cent of the state's sewered population now has sewage treatment, treatment facilities for 65 per cent of the sewered population are in the planning stage.

King (135) suggests that reasonable and workable stream pollution abatement regulations be developed by the state while industry develops controls and methods for its own waste treatment. He stated that the chemical industry is aware of the challenge of the pollution abatement problem, and of the need for industry to treat discharged wastes so that (1) the stream is not harmed to an objectionable degree, (2) the effluent will not make the stream acid nor consume more than a reasonable part of the stream's acid neutralizing power, and (3) not more than a fixed percentage of the stream's dissolved oxygen will be consumed.

Walker (269) stated that the River

Boards Bill in England, when enacted, will set up Boards in various sections of the country for prevention of pollution, but the Boards will be limited by not having sufficient statutory power.

Parker (190) pointed out that the municipality is solely liable for pollution where testimony proves that industrial firms and others comply with municipal ordinances and regulations. However, any user of a sewer who overloads it or violates valid laws may be liable for the pollution of water to the detriment of owners of private property. Where an analysis can be made for direct and demonstrative proof of an injury, the loss of the suit may result if this essential step is omitted.

The Sanitary Water Board of Pennsylvania (11) won an important case against a coal company in its abatement program. Investigation showed that the killing of fish in Aunt Clara's Fork of Kings Creek was caused by dumping of strip mining wastes, and the case was decided in favor of the Board. This Board (10) has issued orders to Publicker Industries of Philadelphia to insure continued abatement of pollution of the Delaware River. The Board also cited a cannery (27) for alleged discharge of chemicals which killed fish in Conewago Creek.

In California, the state (18) has cited 22 communities to force action on sewage treatment to abate stream pollution.

Svore (251) stated that although there are stream pollution problems of considerable magnitude in North Dakota, the state has appropriated no money for pollution control or investigation.

The Ohio River Valley Water Sanitation Compact (188), which created a sanitation district that embraces all territory within the signatory states, the water in which flows ultimately into the Ohio, was signed on June 30, 1948 by representatives of Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Tennessee and West Virginia. This compact provides for an Ohio River Valley Sanitation Commission having three commissioners from each signatory state and three representing the United States Government. The Commission is authorized to adopt, prescribe and promulgate rules, regulations and standards for administering and enforcing the control and abatement of stream pollution within the district.

The Federal Stream Pollution Control Act (37), known as Public Law 845, was passed in 1948. This law authorizes a comprehensive water pollution control program by the United States Public Health Service, and establishes a Water Pollution Control Advisory Board. Either the Surgeon General of the Public Health Service, or a Sanitary Engineer Officer designated by him is to be chairman of this Board. The Board includes one representative from each of the Department of the Army, Department of Agriculture, Department of the Interior, and the Federal Works Agency, and six persons who are not officers or employees of the government, to be appointed by the President. Fourteen river basin offices will implement the program and will cooperate with state and interstate agencies, with municipalities and with industry in their respective watersheds. Research and technical service facilities of the Public Health Service laboratory at Cincinnati are authorized in this program.

Biology and Bacteriology

Bartsch (46) discussed the biological aspects of stream pollution from two points of view: (1) how pollutants change the character of the stream as a habitat for organisms, and (2) the action of organisms upon the pollutant and their related distribution. The distribution of living organisms is altered by pollution and may be used to complete the pollutional picture obtained by the usual testing procedures. A British Field Sports Society report

(12) records the gradual destruction of salmon fisheries as the result of pollution from sewage and industrial wastes. Hora and Nair (119) in India reported that although the effluent from a quinine factory had no apparent direct injurious effect on fish life, the deposit of bark residues affected the feeding grounds. Reid (203) reported that the discharge of lime slurry had a deleterious effect on plant and plankton life.

In studies on the effect of acid and alkalies on fish, Stiemke and Eckenfelder (249) found that bluegill fingerlings reacted differently according either to their stage of development or the season. They reported that alkalies cause more violent death than acids. They proposed the following formula to correlate the pH value and acidity at the time of death:

$$(\text{pH}) \ (\text{Log } C)^n = N_E$$

where C = concentration as p.p.m. expressed as $CaCO_3$; n = constant depending upon the type of acid; N_E = Eckenfelder's number, which was found to have a relatively constant value of 7.4 at the average death point for all acids used. Curves were presented showing the variation between pH and N_E. It was suggested that by using these curves and with the knowledge of the death point for any acid expressed either as pH or N_E one can quickly determine the maximum reduction in pH that can be tolerated in a stream by discharge of an acid waste without harmful effect on the fish.

Stefanile (247) contributed a comparative study of media for the isolation of *E. typhi* in polluted waters. The medium of Leifson detected more contaminated samples than the Kaufmann-Miller, and the Wilson-Blair medium was used for isolating *E. typhi*. A study of the enumeration of faecal *Streptococci* in river water, with a modification of the medium of Hajna and Perry consisting of buffered glucose broth containing azide in a concentration of 1 in 4000 and peptone in place of tryptone, was made by Hannay and Norton (105). Although the maximum count in the presence of azide was not obtained until 32 hours of incubation, both 24- and 48-hour cultures containing azide gave a higher maximum count than the medium containing no azide.

Chemistry

Vosloo (268) reported that the oxygen absorbed from permanganate depends upon the dilution of the sample, and recommends that a standard dilution be accepted to make the results more consistent and comparable. Another modification of the permanganate oxygen absorbed procedure in which the acidified sample treated with 1 ml. of .025 N $KMnO_4$ is boiled for 10 minutes is recommended by Zdeleznikova (287) for field conditions. Ingols (122) developed another dichromate reflux oxygen consumed procedure. In this method the sample is refluxed for 60 minutes with 25 ml. of the oxidizing reagent (1 volume concentrated H_2SO_4, 1 volume 85 per cent H_3PO_4 and 1.25 gram of $K_2Cr_2O_7$), using selenium as a catalyst. The excess $K_2Cr_2O_7$ is determined iodometrically as in the Rhame method, which was reviewed last year. In view of the need for an improved oxygen consumed procedure in stream pollution studies, these procedures deserve further careful study.

Basavilbaso (47) and Ettinger and Ruchhoft (94) studied procedures for the determination of phenol and structurally related compounds with the Gibbs reagent in polluted waters. In the Basavilbaso procedure the sample is treated with a $MnSO_4$–$CuSO_4$ reagent to eliminate sulfides and dissolved oxygen, following which the color is developed with Gibbs reagent in a borate buffered solution and extracted with iso-amyl alcohol. Factors affecting the amount and characteristics of the color produced by the Gibbs reagent, studied by Ettinger and Ruchhoft, included

reaction time, temperature, pH and the 2–6, dibromoquinone chloramide used. Spectrophotometric examination showed that the colors produced varied with the phenolic compound. The details of a procedure designed to take due account of the variables are presented and recommended for application to stream pollution studies where the concentration of these compounds may be very low (under 100 p.p.b.).

Stream Sanitation and Dissolved Oxygen Balance

Lawrence (142) applied the standard oxygen consumed test to the study of the time of passage of pollution (waste sulfite liquor, paper mill wastes with some sewage) in the Androscoggin River. This procedure showed a well-defined molecular front in the river. The cold permanganate number was quite sensitive to small changes in H_2S, and the difference between the hot and cold permanganate numbers gave a valuable index of the fate of a given pollution load.

Crawford (79) studied the dissolved oxygen fluctuations in a typical swamp stream and the effects of sulfate pulp and paper mill discharges to the stream. He concluded that the existing concepts of 4 to 5 p.p.m. of dissolved oxygen for the proper support of aquatic life are not applicable to swamp streams and that the maintenance of an average of 2.5 p.p.m. with a minimum of 2.0 p.p.m. would be satisfactory for native fish life and the esthetic characteristics of the river.

Abbott (5) found photosynthesis an important item in the complex changes occurring in sewage irrigation, and devised a means for determining the biochemical production of oxygen. He suggests that the oxygen-producing capabilities of a sample be determined by incubating duplicate portions at the same temperature in the dark and in the light from a north window for 48 hours.

Studies by Ruchhoft *et al.* (215) (216) and Gotaas (100), which dealt with the biochemical oxygen demand of sewage dilutions, should be mentioned here because of the importance of this parameter in stream studies. These studies indicated that although the general course of the biochemical oxidation in sewage dilutions follows the unimolecular reaction, the values of the velocity constant k at a given temperature vary much more than was considered probable, and the average value of k at 20° C. is considerably higher than the commonly used value of 0.1 found by Phelps and Theriault. The incidence of early nitrification and the effect of early nitrite formation upon the derivation of velocity constants for the first stage obtained by common B.O.D. observations was reported by Ruchhoft, Placak and Ettinger (215). These studies, in which errors due to the formation of minute quantities of nitrite were eliminated, showed a range of k values for first stage oxidation on 45 samples at 20° C. between 0.07 and 0.25, with a skew distribution pattern in which values between 0.16 and 0.20 occurred most frequently. Gotaas (100) concluded that the magnitudes of the ultimate first stage biochemical oxygen demands of sewage are not affected significantly in the range of 5° C. to 30° C., which does not agree with the commonly accepted view that the ultimate first stage B.O.D. increases 2 per cent for each degree increase in temperature.

Standards

Eliassen (89) discussed the classification of all waters into four common groups: (1) sources of drinking water and for cultivation of shellfish, (2) waters used for bathing, (3) recreational and industrial waters, and (4) waters used for commercial navigation and transportation of wastes. Soxirk (242) reported that although the permissible limit of nitrate is not definitely established, water containing 64 to 140

p.p.m. raised varying degrees of severity in cases of methemoglobinemia (blue babies). Dugan (84) suggests 10 p.p.m. of nitrate as the maximum that can be safely used in baby feeding formulae.

Surveys

Lieberman and Hoover (147) studied the effect of forest practices on water quality in the 5500-acre laboratory of the Southeastern Forest Experiment Station situated in the Nantahala Range of the southern Appalachian Mountains. They found that runoff and inorganic slow settling turbidity is greatly increased by logging. Data from controlled logging areas are given. The turbidities are due to soil erosion which results from unplanned and poorly constructed roads.

Felegy, Johnson and Westfield (97) described a study of acid mine water and reported that the main streams and rivers that flow through the anthracite region of Pennsylvania are nearly always alkaline at all points within the region itself. Under present conditions the acid mine drainage appears to be beneficial to the municipalities along the banks because of its neutralizing action on the highly alkaline sewage and industrial wastes. Camp (67) contributed a comprehensive report of the pollution of the Merrimac River by Lowell and Lawrence and surrounding territory, of which 77.5 per cent of the B.O.D. is due to industrial waste. A study of the pollution of the Black Warrior River above Tuscaloosa, Alabama was reported by Dunstan (85).

References

1. Abbott, W. E., "The Bacteriostatic Effect of Methylene Blue on the B.O.D. Test." *Water and Sewage Works*, **95**, 424 (1948).
2. Abbott, W. E., "Suppression of Nitrification and Denitrification During the Determination of Biochemical Oxygen Demand." *Jour. Soc. Chem. Ind.* (Brit.), **67**, 373 (1948).
3. Abbott, W. E., "Mechanism of Activated Sludge Process." THIS JOURNAL, **20**, 841 (1948).
4. Abbott, W. E., "Effect of Sewage Concentration on the Attainable Degree of Purification by the Activated Sludge Process. THIS JOURNAL, **20**, 654 (1948).
5. Abbott, W. E., "Oxygen Production in Waters by Photosynthesis." THIS JOURNAL, **20**, 538 (1948).
6. Allen, L. A., Blezard, N., and Wheatland, A.B., "Formation of Cyanogen Chloride During Chlorination of Certain Liquids. Toxicity of Such Liquids to Fish." *Jour. Hygiene*, **46**, 184 (1948).
7. Allen, L. A., Cooper, A. H., Cairns, A., and Maxwell, C. C., "Microbiology of Beet Sugar Manufacture." *Proc. Soc. Appl. Bact.* (Brit.), No. 1, (1946).
8. Allen, L. A., *et al.*, "Microbiological Problems in the Manufacture of Sugar from Beets. Part I. Corrosion in the Diffusion Battery and in the Recirculation System." *Jour. Soc. of Chem. Ind.* (Brit.), **67**, 70 (1948).
9. Anable, A., and Kite, R. P., "Pollution Abatement. Appraisal of Current Regulations." *Chem. Eng. Progress*, **44**, No. 1, (1948); *Trans. Am. Inst. Chem. Engrs.*, **3**, 16 (1948).
10. Anon, "Board Warns Against Possible Pollution." *Clean Streams*, p. 10 1948.
11. Anon., "Board Wins Important Case in Support of Clean Streams." *Clean Streams*, p. 2 (1948).
12. Anon., "Effect of Chemical Works on Fisheries." *The Chemical Age*, **62**, 1470, 350 (1947); THIS JOURNAL, **20**, 362 (1948).
13. Anon., "Incineration Solves a Waste Disposal Problem." *Chem. Eng.*, **55**, 110 (1948).
14. Anon., "Steel Mill Wastes Converted From Nuisance to Profit." *Chem. Ind.*, **63**, 784 (1948).
15. Anon., "Fats and Waxes from Sewage." *Chemical Trade Journal*, **121**, 321 (1947); THIS JOURNAL, **20**, 363 (1948).
16. Anon., "Device to Speed Sewer Surveys." *Eng. News-Rec.*, **141**, 16, 106 (1948).
17. Anon., "Sludge Digester Insulated with Glass." *Eng. News-Rec.*, **140**, 26, 63 (1948).
18. Anon., "California Pushes Clean-Stream Drive, Calls Halt to Raw Sewage Discharge." *Eng. News-Rec.*, **140**, 7, 3 (1948).

19. Anon., "Potomac Basin Pollution Abatement." *Eng. News-Rec.*, **140**, 4, 63 (1948).
20. Anon., "Viscose Firm Ordered to Treat Wastes." *Interstate Comm. on Potomac River*, **4**, 6, 4 (1948).
21. Anon., "Rock Mills Sewage Disposal Works." *Jour. Inst. of Mun. Eng.* (Brit.), **74**, 181 (1947).
22. Anon., "Electric Motor Drives in Sewage Treatment Field." *Sewage Works Eng.*, **19**, 399 (1948).
23. Anon., "The Use of Chlorine for Odor Control." *Sewage Works Eng.*, **19**, 29 (1948).
24. Anon., "National Survey of Sewage Works Design Requirements." *Sewage Works Eng.*, **19**, 117 (1948).
25. Anon., "Round Table—Sewage Gas Storage and Use." *Sewage Works Eng.*, **19**, 260, 312, 367, 414, 468, 543, 602 (1948).
26. Anon., "Report of By-Pass Survey by Interstate Sanitary Commission." *Sewage Works Eng.*, **19**, 301 (1948).
27. Anon., "Cannery Cited for Criminal Pollution." *Sewage Works Eng.*, **19**, 89 (1948).
28. Anon., "New York State Formulates Model Local Sanitation Code." *Sewage Works Eng.*, **19**, 302 (1948).
29. Anon., "Water Pollution Control Board Proposed for New York State." *Sewage Works Eng.*, **19**, 208 (1948).
30. Anon., "Small Sewage Treatment Plants. Part II.—Primary Settling." *Public Works*, **79**, 3, 24 (1948).
31. Anon., "Central Treatment vs. Several Small Plants." *Public Works*, **79**, 12, 38 (1948).
32. Anon., "Small Sewage Treatment Plants." *Public Works*, **79**, No. 2, 32; No. 3, 24; No. 4, 30 (1948).
33. Anon., "Symposium on New Problems in Sewage Treatment with Special Reference to Synthetic Detergents." Presented at the Institute of Sewage Purification, North Eastern Branch, Feb. 27, 1948. Abstr., THIS JOURNAL, **20**, 949 (1948).
34. Anon., "Sewage Works Equipment and Supplies." THIS JOURNAL, **20**, 958 (1948).
35. Anon., "Central States Sewage Works Association, 1948 Operators' Breakfast Forum." THIS JOURNAL, **20**, 1092 (1948).
36. Anon., "Interesting Extracts from Operating Reports." THIS JOURNAL, **20**, 914 (1948).
37. Anon., "New Federal Pollution Act Establishes Advisory Board." *Water and Sewage Works*, **95**, 242 (1948).
38. Arnold, E. H., "Effects of Low Temperatures on Trickling Filter Operation." *Pub. Works*, **79**, 10, 49 (1948).
39. Babbitt, H. E., "Mechanical Equipment in Sewage Works." Ill. Assoc. of Sanitary Districts, 23rd Annual Report, p. 27 (1947).
40. Backmeyer, D., "Disposal of Liquid Digested Sludge at Marion, Indiana." *Water and Sewage Works*, **95**, 353 (1948).
41. Backmeyer, D., "Disposal of Cheese Whey by Digestion." THIS JOURNAL, **20**, 1115 (1948).
42. Backmeyer, D. P., "The Effect of Whey Upon the Operation of An Activated-Sludge Plant." Proc., Third Ind. Waste Conf., Purdue Univ., p. 310 (1947).
43. Bandt, H. J., "Intensified Injurious Effects on Fish, Especially the Increased Toxic Effect Produced by a Combination of Sewage Poisons." *Beitr. Wasser-Abwasser Fischereichem*, Magdeburg, 15 (1946); *Chem. Abstr.*, **42**, 9015 (1948).
44. Barkholt, H., "Effluent Problems in the Staple Rayon Industry." *Kunstseide u. Zellwolle*, **25**, 312 (1947).
45. Barnes, G. E., "Treatment Works for Plating Wastes Containing Toxic Metals and Cyanides." Proc., Third Ind. Waste Conf., Purdue Univ., p. 179 (1947).
46. Bartsch, A. F., "Biological Aspects of Stream Pollution." THIS JOURNAL, **20**, 292 (1948).
47. Basavilbaso, F., "Determination of Small Quantities of Phenol in Water." Anales Assoc. Quim. Argentina, **35**, 34 (1947); *Chem. Abstr.*, **42**, 3509 (1948).
48. Benoit, R., "Plant for Utilization of Waste Products From Abattoirs." *Schweiz. Arch. Tierhr.*, **88**, 372 (1948).
49. Benson, H. K., "Products from Pulp and Pulpwood on the Pacific Coast." *Paper Trade Jour.*, **126**, 12, 59 (1948).
50. Besselievre, E., "Lime for Industrial Waste Treatment." *Sewage Works Eng.*, **19**, 19 (1948).
51. Bloodgood, D. E., and Losson, F. J., "Removal of Toxic Substances from Metal-Plating Wastes by Ion Exchange." *Proc., Third Ind. Waste Conf., Purdue Univ.*, p. 196 (1947).
52. Bloodgood, D. E., and Canham, R. A., "How Can (Dairy) Plant Losses be Determined?" *Proc., Third Ind. Waste Conf., Purdue Univ.*, p. 293 (1947).
53. Bloodgood, D. E., "Milk Waste Disposal." THIS JOURNAL, **20**, 695, (1948).

54. Bloodgood, D. E., and Hargleroad, J. C., "Anaerobic Digestion of Strawboard Waste." *Paper Trade Jour.*, **127**, 22, 22, 43 (1948).

55. Bolde, A. C., "Waste Treatment Plant of Eastman Gelatine Corporation." *Jour. Boston Soc. Civil Eng.*, **34**, 331 (1947).

56. Bolton, P., "Disposal of Canning Plant Wastes by Irrigation." Proc., Third Ind. Waste Conf., Purdue Univ., p. 272 (1947).

57. Boltz, D. F., and Mellon, M. G., "Spectrophotometric Determination of Phosphorous as Molybdiphosphoric Acid." *Anal. Chem.*, **20**, 749 (1948).

58. Brandon, T. W., "Waste Waters from Beet Sugar Factories—Their Treatment and Disposal." *Int. Sugar Journal*, **49**, 98 (1947).

59. Brandon, T. W., "Results of Operation of Small-Scale Diffusion Batteries (Beet Sugar)." *Int. Sugar Journal*, **49**, 154 (1947).

60. Beedham, C. C., "Some Future Problems in Sewage Purification at Bradford." *Inst. of Sewage Purification* (1947), Abstr. THIS JOURNAL, **20**, 585 (1948).

61. Burley, F. H., "Vacuum Sludge Filtration Practices at the Detroit Sewage Treatment Plant." THIS JOURNAL, **20**, 899 (1948).

62. Buswell, A. M., and Sollo, F. W., Jr., "The Mechanism of Methane Fermentation." *Jour. Amer. Chem. Soc.*, **70**, 1778 (1948).

63. Buswell, A. M., and Sollo, F. W., "Methane Fermentation of a Fiberboard Waste." THIS JOURNAL, **20**, 687 (1948).

64. Cahalan, J. I., "Small Welded Imhoff Tanks." *Sewage Works Eng.*, **19**, 453 (1948).

65. Caldwell, D. H., and Langelier, W. F., Manometric Measurements of the B.O.D. of Sewage." THIS JOURNAL, **20**, 202 (1948).

66. Calise, V. J., "Sludge Contact Reactors in White Water Treatment." *Paper Trade Journal*, **127**, 7, 57 (1948).

67. Camp, T. R., "Report of the Joint Board Established to Investigate and Study and to Prepare Plans and Maps for the Disposal of Sewage of the Merrimack River Valley." Commonwealth of Mass., Senate No. 550; Abstr. *Jour. Boston Soc. Civil Eng.*, **35**, 2, 115 (1948); Abstr. THIS JOURNAL, **20**, 591 (1948).

68. Campanella, J. L., U. S. Patent No. 2,429,868 (1948).

69. Carpenter, C. B., and Mathews, W. W., "Industrial Problems." *Midwest Engineer*, **1**, 2, 2 (1948).

70. Chamberlin, N. S., "Chlorination of Sewage." THIS JOURNAL, **20**, 304 (1948).

71. Chang, S. L., Buckingham, M., and Taylor, M. P., "Studies of Leptospira Icterohaemorrhagiae. IV. Survival in Water and Sewage: Destruction in Water by Halogen Compounds, Synthetic Detergents and Heat." *Jour. Infectious Diseases*, **82**, 256 (1948).

72. Chester, A. E., "The Importance of Mineral-Free Water in the Plating Industry." Proc., Third Ind. Waste Conf., Purdue Univ. Bull., p. 171 (1947).

73. Chipman, W. A., "Physiological Effects of Sulfate Pulp Mill Wastes on Shellfish." *Paper Trade Journal*, **127**, 12, 47 (1948).

74. Clark, L. M., and Hamer, P., "Clarification of Coal Washery Effluent." *Imperial Chemical Industries, Ltd.* (Brit.), 591, (1947); Chem. Abstr., **42**, 3, 1002 1948).

75. Clift, M. A., "Incinerating Wastes from a Large Pharmaceutical Establishment." *Sewage Works Eng.*, **19**, 21 (1948).

76. Cohn, M. M., "Performance of Final Settling Tanks." *Sewage Works Eng.*, **19**, 258 (1948).

77. Cohn, M. M., "Storage of Sludge Gas" and "Sludge Gas Production." *Sewage Works Eng.*, **19**, 363, 465 (1948).

78. Coltart, R. F., "A Pennsylvania Waste White Water Treatment Plant." *Tappi Papers*, Series 31, p. 124 (1948).

79. Crawford, S. C., "Oxygen Balance Studies of a Typical Swamp Stream." THIS JOURNAL, **20**, 876 (1948).

80. Daniels, H. S., and McCarthy, J. L., "The Butyric Acid Fermentation of Sulfite Waste Liquor." *Paper Trade Journal*, **126**, 5, 43 (1948).

81. Davis, W. D., and Silverstein, C. M., "Poliomyelitis: Study of an Epidemic of Forty Cases, Key West, Florida." *U. S. Naval Med. Bull.*, **49**, 910 (1947); Abstr., *Jour. Am. Water Works Assoc.*, **40**, 1127 (1948).

82. Daviss, M. R. V., "Sludge Pumping." *The Surveyor*, **105**, 527 (1948).

83. Dobson, J. G., "The Treatment of Cyanide Waste by Chlorination." Proc., Third Ind. Waste Conf., Purdue Univ., p. 209 (1947).

84. Dugan, F. C., "The Effect of Nitrates in Rural Water Supplies on Infant Health." *Bull. Kentucky Dept. of Health*, **21**, 3 (1948).

85. Dunstan, G. H., "Black Warrior River Pollution Survey." Report of Eng. Exp. Sta., College of Eng., Univ. of Alabama, p. 38; THIS JOURNAL, **20**, 779 (1948).

86. Edmondson, J. H., and Goodrich, S. R., "Experimental Work Leading to Increased Efficiency in the Bio-Aeration Process of Sewage Purification." *Inst. of Sewage Purification* (1947); Abstr. THIS JOURNAL **20**, 771 (1948).

87. Edmondson, J. H., and Goodrich, S. R., "Further Experiments on Nitrification and Re-circulation in Percolating Filters." *Inst. of Sewage Purification* (1947); Abstr. THIS JOURNAL, **20**, 585 (1948).

88. Eldridge, E. F., and Purdy, R. W., "Treatment and Disposal of Waste Soluble Oils." THIS JOURNAL, **20**, 849 (1948).

89. Eliassen, R., "Relationship of the Equities Involved in Stream Usage." *Official Bulletin*, N. Dakota Water and Sewage Works Conf., **15**, 11–12, p. 3 (1948).

90. Eliassen, R., Heller, A. N., and Krieger, H. L., "A Statistical Approach to Sewage Chlorination." THIS JOURNAL, **20**, 1008 (1948).

91. Eskew, R. W., Edwards, R. W., and Redfield, C. S., "Recovery and Utilization of Pulp from White Potato Starch Factories." U. S. Dept. Agric. Pamphlet AIC–204 (1948).

92. Espinosa, A. J., "The Role of Algae in Waste Treatment." *Public Works*, **79**, 8, 36 (1948).

93. Esty, R. W., "A Machine of 101 Uses." *Water and Sewage Works*, **95**, 303 (1948).

94. Ettinger, M. B., and Ruchhoft, C. C., "Determination of Phenol and Structurally Related Compounds by the Gibbs Method." *Anal. Chem.*, **20**, 1191 (1948).

95. Fair, G. M., *et al.*, "The Behavior of Chlorine as a Water Disinfectant." *Jour. Amer. Water Works Assoc.*, **40**, 1051 (1948).

96. Fales, A. L., "A Plating Waste Disposal Problem." THIS JOURNAL, **20**, 857 (1948).

97. Felegy, E. W., Johnson, L. H., and Westfield, J., "Acid Mine Water in the Anthracite Region of Pennsylvania." U. S. Bureau of Mines Tech. Paper, 710, 49 (1948); Abstr. THIS JOURNAL, **20**, 1146 (1948).

98. Gehm, H. W., "Trickling Filters for Treating Pulp and Paper Mill Wastes. Part I." *Water and Sewage Works*, **95**, 231 (1948).

99. Gehm, H. W., "Trickling Filters for Treating Pulp and Paper Mill Wastes. Part II." *Water and Sewage Works*, **95**, 271 (1948).

100. Gotaas, H. B., "Effect of Temperature on Biochemical Oxidation of Sewage." THIS JOURNAL, **20**, 441 (1948).

101. Greeley, S. A., "Considerations and Procedures in the Design of High Rate Trickling Filters." THIS JOURNAL, **20**, 789 (1948).

102. Hall, R. L., "Do Spent Hops and Spent Grain Press Liquor Have Value?" Proc., Third Ind. Waste Conf., Purdue Univ., p. 138 (1947).

103. Haller, J. F., and Listek, S. S., "Determination of Chlorine Dioxide and Other Active Chlorine Compounds in Water." *Anal. Chem.*, **17**, 20, 639 (1948).

104. Halvorsen, G. G., "Diatomaceous Filter Aids for Paper Mill Water and Effluents." *Paper Trade Jour.*, **125**, 18, 37 (1947).

105. Hannay, C. L., and Norton, I. L., "Enumeration, Isolation and Study of Faecal Streptococci from River Water." *Proc., Soc. for Applied Bact.* (England), **194**, 1, 39; Abstr. THIS JOURNAL, **20**, 955 (1948).

106. Hardenbergh, W. A., "High-Rate Filter Performance—A Discussion." THIS JOURNAL, **20**, 622 (1948).

107. Hert, O. H., "Tomato and Pumpkin Wastes." *Proc.*, Third Ind. Waste Conf., Purdue Univ., p. 244 (1947).

108. Herzik, G. R., Jr., "Contact Aeration." *Public Works*, **79**, 8, 26 (1948).

109. Hess, R. W., "Wastes from Chemical Manufacturing." *Water and Sewage Works*, **96**, 36 (1948).

110. Heukelekian, H., "Method for Studying the Toxicity of Industrial Wastes." *Water and Sewage Works*, **95**, 285 (1948).

111. Heukelekian, H., "Some Bacteriological Aspects of Hydrogen Sulfide Production from Sewage." THIS JOURNAL, **20**, 490 (1948).

112. Heukelekian, H., and Kaplovsky, A. J., "Effect of Change of Temperature on Thermophilic Digestion." THIS JOURNAL, **20**, 806 (1948).

113. Heukelekian, H., "Similarities and Differences Between a Biofilter and a Standard Filter." THIS JOURNAL, **20**, 1032 (1948).

114. Heukelekian, H., "Utilization of Chlorine During Septicization of Sewage." *Water and Sewage Works*, **95**, 179 (1948).

115. Hiester, N. K., McCarthy, J. L., and Benson, H. K., "The Separation of Lignin Sulfonic Acids from Sulfite Waste Liquor by Batch Dialysis." *Paper Trade Jour.*, **126**, 16, 58 (1948).

116. Hoak, R. D., *et al.*, "Pickle Liquor Neutralization." *Ind. Eng. Chem.*, **40**, 2062 (1948).

117. Hoak, R. D., "Refinery Waste Disposal —XIX. Modifications of Oil-Water Separators to Meet Specialized Applications." *Petroleum Processing*, **2**, 632 (1948); Abstr. THIS JOURNAL, **20**, 363 (1948).

118. Hood, J. W., "Measurement and Control of Sewage Treatment Process Efficiency by Oxidation-Reduction Potential." THIS JOURNAL, **20**, 640 (1948).

119. Hora, Sunder Lal., and Nair, K. K., "Pollution of Streams and Conservation of Fisheries." *Proc. Nat. Inst. Sci.* (India), **10**, 147 (1944); *Chem. Abstr.*, **42**, 4696 (1948).

120. Horton, R. K., Pacheco, M., and Santana, M. F., "Studies on the Treatment of Coffee Mill Wastes." *Jour. Inter-American Assoc. San. Eng.*, **11**, 4, 397 (1948).

121. Hutchinson, O. F., "Actual and Potential White Water System With the Sveen-Pederson Saveall." *Paper Trade Jour.*, **127**, 23, 44 (1948).

122. Ingols, R. S., and Murray, P. E., "An Oxygen Consumed Test for Sewage." *Water and Sewage Works*, **95**, 113 (1948).

123. Jenkins, S. H., Hewitt, C. H., and Winsor, C. E., "Large Scale Experiments on the Sedimentation of Sewage in Rectangular Tanks." *The Surveyor*, **106**, 669 (1947).

124. Jensen, K. A., and Jensen, K. E., "Occurrence of Tubercle Bacilli in Sewage and Experiments on Sterilization of Tubercle Bacilli Containing Sewage with Chlorine." *Acta Tuberculosia Scandinavia*, **217**, 16–17 (1942–1943); Abstr. THIS JOURNAL, **20**, 1141 (1948).

125. Jones, E. E., "Waste Waters From an Abattoir." *The Surveyor*, **107**, 159 (1948).

126. Jones, Myrna, F., Newton, W. L., Weibel, S. R., Warren, H. B., Steinle, M. L., and Figgat, W. B., "The Effects of Sewage Treatment Processes on the Ova and Miracidia of Schistosoma Japonicum." Part I. Nat. Inst. of Health Bull. No. 189, p. 137 (1947).

127. Kahn, J. M., "The Application of a Flocculation Type Unit in Paper Mill White Water Treatment." *Paper Trade Jour.*, **127**, 24, 57 (1948).

128. Kalinske, A. A., "Waste Treatment in Pilot Plant Using Water-Softening Sludge." *Sewage Works Eng.*, **19**, 449 (1948).

129. Kalinske, A. A., "Settling Characteristics of Suspensions in Water Treatment Processes." *Jour. Amer. Water Works Assoc.*, **40**, 113, (1948).

130. Keefer, C. E., "Pumping Sewage Automatically." *Eng. News-Rec.*, **141**, 10, 88 (1948).

131. Keefer, C. E., "A New Method of Heating Sludge Digesters." *Water and Sewage Works*, **93**, 236 (1946).

132. Kehr, W. Q., and Ruchhoft, C. C., "A Study of the Effect of Sewage Distribution on High Rate Filter Efficiency." Report of Dept. of Pub. Health and Welfare of Missouri and U. S. Public Health Service (1947).

133. Kennedy, D. R., "Sewer Maintenance Experience at Long Beach, Calif." THIS JOURNAL, **20**, 104 (1948).

134. Kiker, J. E., Jr., "University of Florida Sewage Treatment Research." *Public Works*, **79**, 9, 30 (1948).

135. King, V. L., "Industrial Stream Pollution Regulations." THIS JOURNAL, **20**, 679 (1948).

136. Klassen, C. W., and Troemper, A. P., "Wastes from a Whiskey Distillery—Sources and Characteristics." *Proc.*, Third Ind. Waste Conf., Purdue University, p. 153 (1947).

137. Kluyver, A. J., and Schnellen, G. T. P., "On the Fermentation of Carbon Monoxide by Pure Cultures of Methane Bacteria." *Archives of Biochem.*, **14**, 1 (1947).

138. Knox, W. E., Green, D. E., and Auerbach, V. H., "The Inhibition of Sulfhydryl Enzymes as the Basis of the Bactericidal Action of Chlorine." *Jour. Bact.*, **55**, 451 (1948).

139. Kunsch, W. M., "Sludge Digestion Experiences With the External Heat Exchanger." THIS JOURNAL, **20**, 999 (1948).

140. Laidlaw, G. C., "Effect of Hydrogen Sulfide in Winnipeg Sewage." *Water and Sewage*, **86**, 10, 16 (1948).

141. Larson, L., "Two Story Sedimentation Basin Features Filter Plant Layout." *Eng. News-Record*, **140**, 18, 110 (1948).

142. Lawrence, W. A., "Determination of the Time of Passage of Pollution in the Androscoggin River." THIS JOURNAL, **20**, 881 (1948).

143. Leibee, H. C., and Smith, Randolph L., "Second Stage Filter Removals without Recirculation." *Public Works*, **79**, 11, 22 (1948).

144. Leonard, R. H., Peterson, W. H., and Johnson, M. J., "Lactic Acid From Fermentation of Sulfite Waste Liquor." *Ind. and Eng. Chem.*, **40**, 57 (1948).

145. Le Vine, R. Y., "Lime Treatment of Tomato Canning Waste." *Public Works*, **79**, 10, 28 (1948).

146. Lewis, H. F., "A Review of By-Products of Sulfite Pulping." *Paper Trade Jour.*, **127**, 2, 51 (1948).

147. Lieberman, J. A., and Hoover, M. D., "The Effect of Uncontrolled Logging on Stream Turbidity." *Water and Sewage Works*, **95**, 255 (1948).

148. Lockett, W. T., and Griffiths, J., "Cyanides in Trade Effluents and Their Effect on the Bacterial Purification of Sewage." Inst. of Sewage Purification (1947); Abstr. THIS JOURNAL, **20**, 357 (1948).

149. Logan, J. O., "Handling Chlorine Safely." *Water and Sewage Works*, **95**, 333 (1948).

150. Logan, J. O., "Chlorine Supply and Demand." *Jour. Amer. Water Works Assoc.*, **40**, 837 (1948).

151. Logan, R. P., and Heukelekian, H., "Liquid-Phase and Foam-Phase Oxidation of Waste Sulfite Liquor." THIS JOURNAL, **20**, 282 (1948).

152. Logan, R. P., and Le Vine, R. Y., "Lime Treatment of Cranberry Packing Wastes." *Sewage Works Eng.*, **19**, 635 (1948).

153. Longley, J. R., "Cleaning Air Diffuser Plates by Sandblasting." *Water and Sewage Works*, **95**, 363 (1948).

154. Lumb, C., and Barnes, J. P., "The Periodicity of Dosing Percolating Filters." *The Surveyor*, **107**, 387 (1948).

155. Manchester (England), "Report, Rivers Department, for Two Years Ending March 31, 1946." *The Surveyor*, **107**, 133 (1948); Abstr. THIS JOURNAL, **20**, 945 (1948).

156. Marcali, K., and Rieman, W., "Kjeldahl Determination of Nitrogen Without Distillation." *Anal. Chem.*, **20**, 381 (1948).

157. Marks, H. C., Joiner, R. R., and Strandskov, F. B., "Amperometric Titration of Residual Chlorine in Sewage." *Water and Sewage Works*, **95**, 175 (1948).

158. Marks, H. C., and Joiner, R. R., "Determination of Residual Chlorine in Sewage." *Anal. Chem.*, **20**, 1197 (1948).

159. McBee, R. H., "The Culture and Physiology of a Thermophilic Cellulose-Fermenting Bacterium." *Jour. Bact.*, **56**, 653 (1948).

160. McCormick, C. D., "How Can the Wastes from a Plating Room Be Decreased?" Proc., Third Ind. Waste Conf., Purdue Univ., p. 191 (1947).

161. Melnick, J. L., "Poliomyelitis Virus in Urban Sewage in Non-Epidemic Times." *Amer. Jour. Hyg.*, **45**, 240 (1947); Abstr. THIS JOURNAL, **20**, 175 (1948).

162. Miller, P. E., "Canning Plant Wastes and Sewage Treatment." *Proc.*, Third Ind. Waste Conf., Purdue Univ., p. 263 (1947).

163. Milling, M. A., "An Activated Sludge Improvement." *Amer. City*, **43**, 118 (1948).

164. Moggio, W. A., "Storage Studies on Kraft Mill Wastes." National Council for Stream Improv., Research Rep. 19 (1948); Eng. Exp. Sta. Bull. 13, La. State Univ. (1948).

165. Moggio, W. A., "Methods for the Determination of the B.O.D. of Kraft Mill Waste." National Council for Stream Improv., Research Rep. 18 (1948).

166. Mohlman, F. W., "High-Rate Filter Performance." THIS JOURNAL, **20**, 618 (1948).

167. Mohlman, F. W., "Possibilities of Recovery and Utilization of Industrial Wastes." *Proc. Am. Soc. Civ. Eng.*, **74**, 1052 (1948).

168. Mohlman, F. W., "Discussion of Waste Waters From an Abattoir." *The Surveyor*, **107**, 294 (1948).

169. Moore, E. W., Morris, J. C., and Okun, D. A., "The Polarographic Determination of Dissolved Oxygen in Water and Sewage." THIS JOURNAL, **20**, 1041 (1948).

170. Morgan, P. F., "The Determination of the Type and Degree of Treatment Required for An Industrial Waste Problem." *Proc.*, Third Ind. Waste Conf., Purdue Univ., p. 74 (1947).

171. Morgan, P. F., "Biological Treatment of Deinking Waste." *Paper Trade Jour.*, **126**, 20, 41 (1948).

172. Morris, J. C., and Carritt, J. B., "Contamination of Water Supplies by Radioactive Substances." *Jour. New England Water Works Assoc.*, **62**, 11, (1948).

173. Myers, J., "Studies of Sewage Lagoons." *Public Works*, **79**, 12, 25, (1948).

174. Nance, E. L., "Twenty Years of Vacuum Sludge Filtration at Charlotte, N. C." *Sewage Works Eng.*, **19**, 355 (1948).

175. National Council for Stream Improvement, "Pilot Plant Studies on Waste Treatment." Research Report 17 (1948).

176. National Council for Stream Improvement, "Summary of Trickling Filter Treatment." Research Report 20 (1948).

177. National Council for Stream Improvement, "Report on Methods of Treating Deinking Wastes." Research Report 22 (1948).

178. National Council for Stream Improve-

ment, "Treatment of Strawboard Wastes." Research Report 15 (1947).
179. National Research Council, Division of Medical Science, Report of the Subcommittee on Sewage Treatment, "Sewage Treatment at Military Installations —Summary and Conclusions." THIS JOURNAL, **20**, 52 (1948).
180. Nelson, F. G., "Pretreatment of Carbohydrate Industrial Wastes." THIS JOURNAL, **20**, 531 (1948).
181. Nevitt, I. H., "Sewage-Sludge Digestion at the North Toronto Sewage-Treatment Plant." *Water and Sewage*, **86**, 11, 57 (1948).
182. Newton, W. L., and Figgat, W. B., and Weibel, S. R., "The Effects of Sewage Treatment Processes Upon Ova and Miracidia of Schistosoma Japonicum. Part II." THIS JOURNAL, **20**, 657 (1948).
183. Niles, A. H., "Aeration Plant to Protect Toledo's Lake Water." *Sewage Works Eng.*, **19**, 587 (1948).
184. Nottingham, M. C., and Ludwig, Harvey F., "Septic Tank Performance as Related to Tank Length, Width and Depth." *Water and Sewage Works*, **95**, 460 (1948).
185. Nussbaumer, N. L., "Pilot Plant for Treatment of Phenol-Still (Coke) Wastes." THIS JOURNAL, **20**, 872 (1948).
186. Nussberger, F., "Determination of Hydrogen Sulfide In Digester Gas." THIS JOURNAL, **20**, 499 (1948).
187. Oeming, L. F., "Milk Waste Treatment at the Detroit Creamery Company Condensery, Ovid, Michigan." THIS JOURNAL, **20**, 512 (1948).
188. Ohio River Valley Water Sanitation Compact. *Water and Sewage Works*, **95**, 242 (1948).
189. Okun, Daniel A., "Pure Oxygen in Bioprecipitation Process May Reduce Sewage Treatment Costs." *Civil Eng.*, **18**, 32 (1948).
190. Parker, Leo T., "Pollution Law Suits." *Sewage Works Eng.*, **19**, 183, 179, 180 (1948).
191. Pearl, I. A., "Utilization of Sulfite Waste Liquor." *Chem. Eng. News*, **26**, 2950 (1948).
192. Pearse, L., "Oxidation Ponds." (APHA Committee Report.) THIS JOURNAL, **20**, 1025 (1948).
193. Pearse, Langdon, "Sludge Lagoons." THIS JOURNAL, **20**, 817 (1948).
194. Pearson, I. A., and Hammer, J. M., and Corrigan, K. E., and Hayden, H. S., "Studies on the Behavior of Fungi in the Presence of Radioactive Isotopes." *Jour. of Bact.*, **56**, 397 (1948).
195. Perry, L., "Trapping Sand in Water." *Eng. News-Record*, **140**, 87 (1948).
196. Petty, A. W., "Alkalinity Control of the Trickling Filter Process at Virginia Beach." THIS JOURNAL, **20**, 566 (1948).
197. Pillai, S. C., and Wadhwani, T. K., and Gurbaxani, M. L., and Subrahmanyan, "Role of Protozoa in the Concentration of Nitrogen in the Sludge during Aerobic Purification of Sewage." *Current Science* (India), **17**, 93 (1948); *Chem. Abstr.*, **42**, 6028 (1948).
198. Pillai, S. C., and Wadhwani, T. K., and Gurbaxani, M. I., and Subrahmanyan, V., "Relative Efficiency of Bacteria and Protozoa in the Flocculation and Oxidation of Organic Matter Suspended in Water." *Current Science* (India), **16**, 340 (1947).
199. Peopel, Franz, "Gaserzeugung und Stoffverluste bei der Schlammfaulung." *Gesundheits-Ingenieur*, **68**, Jahrg. 85 (1947).
200. Pomeroy, Richard, "Power Efficiency in Sludge Aeration." THIS JOURNAL, **20**, 222 (1948).
201. Rankin, R. S., "Digester Capacity Requirements." THIS JOURNAL, **20**, 478 (1948).
202. Rawn, A. M., and Candel, E. J., "Some Effects of Anaerobic Digestion of Sewage Sludge." *Proc. Amer. Soc. Civil Eng.*, **74**, 1476 (1948).
203. Reid, Geo. W., "Controlling Stream Pollution." *Southern Power and Ind.*, **66**, 1, 80 (1948); *Chem. Abstr.*, **42**, 2041 (1948).
204. Reuning, Howard T., "Disposal of Vegetable Tanning Wastes." THIS JOURNAL, **20**, 525 (1948).
205. Reuning, H. T., "An Effective Tannery Waste Treatment Plant." *Public Works*, **78**, 3, 21 (1947).
206. Rhame, G. A., "Determination of B.O.D Values by Chemical Oxidation." *Water and Sewage Works*, **94**, 192 (1947).
207. Richheimer, Charles E., and Parks, Walter J., Jr., "New Sewage Plant Provides for Treatment, Research, Instruction." *Sewage Works Eng.*, **19**, 200 (1948).
208. Ridenour, G. M., "Laboratory Studies on Effect of Alkali—Chlorinated Cyanide, Case Hardening, Copper and Zinc Plating Wastes on Aerobic and Anaerobic Sewage Treatment Processes." THIS JOURNAL, **20**, 1059 (1948).
209. Ridgway, John W., and Baldyge, W. V., and Searba, M., "Progress on Spray Drying of Distiller's Solubles." *Proc.*, Third Ind. Waste Conf., Purdue Univ., p. 128 (1947).

210. Riehl, M. L., "Analytical Procedures for the Determination of Metals Affecting Sewage Treatment." THIS JOURNAL, **20**, 629 (1948).
211. Roberton, L. F., "Disposal of Sludge in Liquid Form for Use as a Fertilizer." *Water and Sewage*, **86**, 11, 56 (1948).
212. Roe, Frank C., "The 'Wide Band' Air Diffusion System." THIS JOURNAL, **20**, 1054 (1948).
213. Ross, L., "New 80,000 Gallon per Minute Oil-Water Separator Deviates from Conventional Design." *Petroleum Processing*, **3**, 114 (1948); Abstr. THIS JOURNAL, **20**, 956 (1948).
214. Ross, Logan, "New 80,000 G.P.M. Oil-Water Separator Deviates From Conventional Design." *Petroleum Processing*, **3**, 114 (1948).
215. Ruchhoft, C. C., and Placak, O. R., and Ettinger, M. B., "Correction of B.O.D. Velocity Constants for Nitrification." THIS JOURNAL, **20**, 832 (1948).
216. Ruchhoft, C. C., and Placak, O. R., and Kachmar, John F., and Calbert, C. E., "Variations in B.O.D. Velocity Constants of Sewage Dilutions." *Ind. Eng. Chem.*, **40**, 1290 (1948).
217. Rudolfs, W., and Axe, E. J., "Quality Variations in Paper Mill Wastes. Part I." *Sewage Works Eng.*, **19**, 63 (1948).
218. Rudolfs, W., and Axe, E. J., "Quality Variations in Paper Mill Wastes. Part II." *Sewage Works Eng.*, **19**, 245 (1948).
219. Rudolfs, W., and Axe, E. J., "White Water Treatment and Recovery. Part I." *Water and Sewage Works*, **95**, 219 (1948).
220. Rudolfs, W., and Axe, E. J., "White Water Treatment and Recovery. Part II." *Water and Sewage Works*, **95**, 268 (1948).
221. Rudolfs, W., and Palladino, A. J., "Concentration of White Water Sludges. Part I." *Paper Trade Journal*, **126**, 20, 31 (1948).
222. Rudolfs, W., and Palladino, A. J., "Concentration of White Water Sludges. Part II." *Paper Trade Journal*, **126**, 21, 27 (1948).
223. Rudolfs, W., and Palladino, A. J., "White Water Treatment and Recovery. Part III." *Water and Sewage Works*, **95**, 329 (1948).
224. Rudolfs, W., and Palladino, A. J., "White Water Treatment and Recovery. Part IV." *Water and Sewage Works*, **95**, 419 (1948).
225. Rudolfs, W., and Trubnick, E. H., "Compressed Yeast Waste Treatment. I. Nature of Material and Physical-Chemical Characteristics." THIS JOURNAL, **6**, 1084 (1948).
226. Sanders, M. C., "What Can be Done with Whey?" *Proc.*, Third. Ind. Waste Conf., Purdue Univ., p. 288 (1947).
227. Sanders, M. D., "Chemical Precipitation of Meat Packing Wastes." *Ind. Eng. Chem.*, **40**, 1151 (1948).
228. Sax, N. I., "Photometer Measures Dissolved Silica." *Power*, **91**, 88 (1947); *Chem. Abstr.*, **42**, 1365 (1948).
229. Scheurer, N., "Four Wastes, One Effluent, American Viscose." *Chem. Eng.*, **5**, 138 (1948).
230. Schneider, W. A., "Chlorination of Los Angeles Sewage at Hyperion Plant." *Water and Sewage Works*, **95**, 77 1948).
231. Schnellen, G. T. P., "Studies on Methane Fermentation." (Doctor's Thesis.) *Delft* (Netherlands) (1947).
232. Schofield, E. R., and Tark, M. B., "New Heating System for Sludge Digestion." *Water and Sewage Works*, **95**, 172 (1948).
233. Setter, L. R., "Air Diffusion Problems at Activated Sludge Plants." *Water and Sewage Works*, **95**, 450 (1948).
234. Sheen, R. T., "White Water Treatment —An Industrial Waste Problem." *Paper Trade Journal*, **126**, 9, 106 (1948).
235. Siebert, C. L., and Allison, C., "Some Rights and Wrongs of Cannery Waste Treatment." *Water and Sewage Works*, **95**, 227 (1948).
236. Sigga, S., and Edsberg, R. L., "Determination of Alkyl Sulfides and Disulfides." *Anal. Chem.*, **20**, 938 (1948).
237. Simpson, R. W., "DDT Emulsion May Damage Filter Growths." *Sewage Works Eng.*, **19**, 23 (1948).
238. Smith, C. A., "Basic Design Factors for Sedimentation and Filtration." *Sewage Works Eng.*, **19**, 136 (1948).
239. Southgate, B. A., "Reuse of Waste Waters from Industrial Processes." *Inst. of Chem. Eng.*, 8 (1947); Abstr. THIS JOURNAL, **20**, 169 (1948).
240. Southgate, B. A., "Recent Developments in Treatment of Industrial Effluents." *Civil Eng.*, **43**, 636 (1948).
241. Southgate, B. A., "A British Standard Specification for Media for Percolating Filters." *Surveyor*, **107**, 467 (1948).
242. Soxirk, Russell O., "Public Health Aspects of Nitrates in Drinking Water." *Official Bulletin*, N. Dakota Water and Sewage Works Conf., **15**, 10 (1948).
243. Sphar, L. L., "Embedded Coils Heat Sludge Digesters." *Eng. News-Record*, **139**, 2, 119 (1947).
244. Stanier, R. Y., "The Oxidation of Aromatic Compounds by Fluorescent Pseu-

domonads." *Jour. Bact.*, **55**, 477 (1948).

245. Stanley, W. E., and Berberich, J. F., "B.O.D. Loadings in Activated Sludge Plants." *Jour. Boston Soc. Civil Eng.*, **35**, 236 (1948).

246. Starkey, Robert L., "Characteristics and Cultivation of Sulfate-Reducing Bacteria." *Jour. Amer. Water Works Assoc.*, **40**, 1291 (1948).

247. Stefanile, Alfredo, Armando, "Detection of Eberthella Typhi in Water." *Rev. Floculated Cienc Qui M.*, **20**, (1945); *Chem. Abstr.*, **42**, 2373 (1948).

248. Steffen, J. A., "What to do About Paunch Wastes." *Proc.*, Third Ind. Waste Conf., Purdue Univ., p. 268 (1947).

249. Stiemke, R. E., and Eckenfelder, W. W., "A Practical Method for Predicting Effects of Common Acids and Alkalies on the Survival of Fish." Bulletin 33, Department of Engineering Research, North Carolina State College, (1947); Abstr. THIS JOURNAL, **20**, 592 (1948).

250. Strand, J. A., "Sand Filters and Chlorination Used Seasonally at Small Plant." *Sewage Works Eng.*, **19**, 14 (1948).

251. Svore, Jerome H., "Problems of Sanitation in N. Dakota." *Official Bulletin*, N. Dakota Water and Sewage Works Conf., **15**, 3 (1948).

252. Tatlock, M. W., "Treatment of Yeast Products Wastes." *Proc.*, Third Ind. Waste Conf., Purdue Univ., p. 111 (1947).

253. Taylor, Frank, S., "Use of Cloroben for Odor Control." THIS JOURNAL, **20**, 917 (1948).

254. Templeton, C. W., "Dehydration of Tomato Wastes." *Proc.*, Third Ind. Waste Conf., Purdue Univ., p. 258 (1947).

255. Tomlinson, T. G., "Growth and Distribution of Film in Percolating Filters Treating Sewage by Single and Alternating Double Filtration." *Inst. Sewage Purif. Journal and Proc.*, Part I, 168 (1946).

256. Tomlinson, T. G., and Jenkins, S. H., "Control of Flies Breeding in Percolating Sewage Filters." Reprint, Public Works, Roads and Transport Congress (1947).

257. Torpey, W. N., "Practical Results of Step Aeration." THIS JOURNAL, **20**, 781 (1948).

258. Tyler, R. G., and Maske, W., "Fooder Yeast Produced from Sulfite Waste Liquor." THIS JOURNAL, **20**, 516 (1948).

259. Tyler, R. G., and Gunter, S., "Biochemical Oxygen Demand of Sulfite Waste Liquor." THIS JOURNAL, **20**, 709 (1948).

260. Van Horn, W., "A Study of the Toxic Components of the Waste Water of Five Typical Kraft Mills." National Council for Stream Improvement, Research Report 16 (1948).

261. Van Huben, L. C., "Ensilage Cutter Pinch Hits as Digester Degasifier." *Sewage Works Eng.*, **19**, 83 (1948).

262. Van Kleeck, Leroy W., "Digestion of Sewage Solids." *Water and Sewage Works*, **95**, 104, 155, 163, 237, 325, 357, 457 (1948).

263. Vaseen, V. A., "World's Highest Sewage Plant." *Sewage Works Eng.*, **19**, 446 (1948).

264. Vaseen, V. S., "A Warm Wall Sludge Digester." *Sewage Works Eng.*, **19**, 247 (1948).

265. Vaseen, V. A., "Reducing Heating Maintenance Cost on Sewage Treatment Digesters." *Public Works*, **79**, 9, 33 (1948).

266. Veatch, N. T., "Industrial Uses of Reclaimed Sewage Effluents." THIS JOURNAL, **20**, 3 (1948); *Jour. Amer. Water Works Assoc.*, **40**, 1 (1948).

267. Velz, C. J., "A Basic Law for the Performance of Biological Filters." THIS JOURNAL, **20**, 607 (1948).

268. Vosloo, P. B. B., "Proposal for a More Rigid Standardization of the 'Oxygen Absorbed from Permanganate Test.'" *Public Health* (Johannesburg), **2**, 7, 11 (1947); *Chem Abstrs.*, **42**, 702 h (1948).

269. Walker, G. E., "Rivers Pollution Prevention." *Surveyor*, **107**, 328 (1947).

270. Walker, Donald J., "Sludge Digestion and Methane Production." THIS JOURNAL, **20**, 544 (1948).

271. Washburn, G. N., "The Toxicity to Warm Water Fishes of Certain Cyanide Plating and Carburizing Salts Before and After Treatment by the Alkali Chlorination Method." THIS JOURNAL, **20**, 1074 (1948).

272. Water Pollution Research Board, "Flax Retting with Aeration" (Brit.). Dept. of Scientific and Industrial Research, Water Pollution Research, Technical Paper 10.

273. Water Pollution Research Board, "Report of Dept. of Scientific and Industrial Research (Great Britain)," 39 (1947). Abstr. THIS JOURNAL, **20**, 944 (1948).

274. Watson, Kenneth S., "West Virginia Surveys Pollution in the 'Ruhr of U. S. Chemical Industry.'" *Sewage Works Eng.*, **19**, 346 (1948).

275. Watson, W. N., "Organizations and Method for Investigating Wastes in

Relation to Water Pollution." Mfg. Chem., Assn., Manual W–1 (1948).
276. Weston, R. F., "Some Fundamentals on Water Pollution for Industry." THIS JOURNAL, **20**, 682 (1948).
277. West Riding of Yorkshire Rivers Board, "Report Upon Trade Refuse-Coal Trade." West Riding of Yorkshire Rivers Board (Brit.), Bull. 183 (1948).
278. Wilcox, L. V., "Agricultural Uses of Reclaimed Sewage Effluent." THIS JOURNAL, **20**, 24 (1948).
279. Wirts, J. J., "Commercial Utilization of Waste Digester Gas." THIS JOURNAL, **20**, 923 (1948).
280. Wise, W. S., "The Industrial Waste Problem. IV. Brass and Copper, Electroplating and Textile Wastes." THIS JOURNAL, **20**, 96 (1948).
281. Wishart, J. M., Jepson, C., and Klein, L., "Dewatering of Sewage Sludge by Coagulation and Vacuum Filtration—Part II. Experiments with a Semi-scale Dorr-Oliver Vacuum Filter." City of Manchester, Rivers Dept., Report for Two Years Ended March 31 (1946). Inst. Sewage Purif. (1947). Abstr. THIS JOURNAL, **20**, 163 (1948).
282. Witcher, C. P., "Annual Operation Report 1946." Abstr. THIS JOURNAL, **20**, 914 (1948).
283. Wittmer, E. F., "Alternating Two Stage Filtration of Sewage and Milk Waste." THIS JOURNAL, **20**, 846 (1948).
284. Woelfel, W. C., "Colorimetric Determination of Copper With Carbon Disulfide and Diathanolamine." *Anal. Chem.*, **20**, 722, (1948).
285. Wolman, A., "Industrial Water Supply from Processed Sewage Treatment Plant Effluent at Baltimore, Md." THIS JOURNAL, **20**, 15 (1948).
286. Wolman, A., and Clark, L. K., "Human Waste Disposal from Railroad Passenger Cars." *Amer. Jour. of Public Health*, **38**, 652 (1948).
287. Zdeleznikova, N. S., "Comparative Evaluation of Methods of Determination of Oxidizability of Water under Field Conditions." *Voenno-Med. Zhur.* (1946), No. 7/8, 47–9; *Chem. Abstr.*, **42**, 2039 (1948).

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Industrial Wastes

COMPANY ADMINISTRATION AND TECHNICAL ORGANIZATION FOR INDUSTRIAL WASTE CONTROL *

By R. R. Balmer

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Industrial waste disposal problems within a company create the need for three things: (1) a company policy on the subject, (2) administrative procedures to carry out that policy, and (3) an organization to investigate and develop proper disposal facilities. This discussion is concerned with the waste organization and administrative requirements for industrial companies of various sizes. Several actual examples will be cited and the pollution abatement activities of the company represented by the writer will be described in detail.

The Company Waste Control Organization

The Small Company

Where a company is small, perhaps of the owner-manager size, the whole pollution abatement organization may be represented by one man, the manager himself. If a little larger, there may be a plant engineer who will join in the work. In this case, these one or two men know every operation, product, by-product, and waste of the processes carried out. If these facts are not known they can readily be determined. If any disposal problems arise, they rely on their own knowledge for a solution. When outside assistance is needed, the state health department or other pollution control agency may be of some assistance, but a consulting engineer may finally have to be called in if the problem is particularly difficult.

As an example, consider an imaginary situation where a company's only operation is the grinding of lenses for eye-glasses. The owner actively manages the business and employs less than 30 people. For years the sanitary sewage and the wastes from the grinding operation have gone to a small stream. With the advent of new laws and their enforcement a warning is received from the state pollution control agency to stop polluting the stream. The first step to be taken by Mr. Owner would be a conference with the state authorities to determine the extent of the pollution, the degree of improvement required and possible methods of treatment to produce a satisfactory effluent. The amount of assistance which can be obtained from the state authorities will vary considerably. Some states will give practically no help, maintaining that they are not in a position to assist in solving the problems of industry while other states may go a long way toward helping to solve the problem.

In most cases the state or county health department will have enough information readily available so that Mr. Owner can proceed to treat sanitary wastes, but in the case of his industrial wastes the state is not equipped to supply the complete answer. Although trade journals have had articles deal-

* Presented at Twentieth Annual Conference, Pennsylvania Sewage and Industrial Wastes Assn., State College, August 26, 1948.

ing with waste disposal, there is not enough specific information available to apply directly to these particular circumstances. Mr. Owner will then have to call in a consulting engineer and work with him in developing the best solution to the problem. Such is the brief story of the usual small company solution of a waste problem where no public sewers are available. Where the quality of the wastes is harmless to sewers or treatment processes, a connection to an accessible sewer system may be the most economical procedure. Pre-treatment methods can be used to alter or remove objectionable qualities of the wastes where necessary.

The Medium-Size Company

When a company has developed so that it has waste problems at several plants or many problems at one location, it then becomes necessary to have a definite pollution abatement organization. At each plant there should be one man at the head of the waste activities. He should preferably be a chemist or an engineer thoroughly familiar with all the operations being carried on and be especially able to work with other people.

This waste specialist will need a laboratory to carry out the analytical work, and manpower assistance to set up sampling and flow measuring devices necessary in carrying out waste surveys. He should have authority to request engineering assistance when any construction is being considered and assistance from technical and operating personnel when delving into the possibilities of process changes. The active support of management will be needed in carrying out an educational campaign among employees, and in making the necessary funds available for carrying out the program and installing needed equipment.

The Atlantic Refining Company waste control organization at Philadelphia is an excellent example of what may be developed where many problems exist at one plant. Here, the organization includes a waste specialist, two assistants and a staff of eleven men who are laboratory workers and mechanics. There is also a separate laboratory for waste analyses and semi-works scale equipment for testing various treatment processes. Close liaison is maintained with the operating, research and development, and engineering departments.

Where a company has several scattered plants with waste problems, it is desirable not only to have the individual plant organizations as outlined above but also to have an over-all company waste specialist. His duties would be to coordinate the efforts of the several plant groups and provide an exchange of information between them. If the plant's problems are of a similar nature, it may be possible to use men on the plant waste jobs who are not as highly specialized as would be necessary if they could not call on the company waste specialist for guidance and technical assistance. The services of an outside consultant may still be desirable on special problems. A company operating several textile mills would be an example where this type of organization might be desirable.

The Large Company

The waste organization for a large company is the same as the one outlined for the medium-sized company except that refinements are added which require a larger central staff and coordination with other specialized groups not existing in smaller companies. One device used by du Pont for coordination of effort—described in detail later—is a company-wide pollution abatement committee. The General Motors Corporation also has a similar committee and undoubtedly other large companies use the same device.

The location of the working force spearheading a company's abatement program may fall under any of several departments, such as administration,

engineering, development, or operations, but in a majority of cases it seems advisable to choose the engineering department. The extent of work performed beyond that of promotion and coordination varies widely and depends to a great extent on the particular company organization.

While the large company may not be of interest to a majority of people, it does become a good example of details, some of which may be of benefit to the small or medium-size company under special circumstances. The section below on "Administration of Waste Control Program" is given from the large company point of view.

The above description of waste control organizations has been based on the size of a company, but there are some notable exceptions to such an assumption. In the utilities field some very large companies operate at numerous locations in many states, yet, by the nature of their business, wastes rarely become a problem. These large companies need only to use the small business approach of having the local manager solve any small problem, and call in a consultant if needed for any unusual and difficult circumstances.

Administration of Waste Control Program

The basic administrative step needed for the functioning of a waste control program is the establishment and issuance by top management of a policy regarding waste disposal and stream pollution. It should clearly indicate that management requires adequate consideration of waste disposal so that no conditions will be created which cause nuisance or damage or violate established governmental regulations. In addition, management must express a willingness to allocate funds for waste disposal work and establish rules which require the inclusion of necessary waste disposal facilities in each new project for which money is granted.

To carry out the company policy the responsibilities and functions may be broken down by departments as follows:

Research and Development Department

Each new process developed should not be considered complete until the volume and characteristics of the wastes produced have been determined and possible treatment methods devised. If research people are aware of the restrictions likely to be placed on wastes, process methods may sometimes be devised which will reduce or eliminate waste treatment requirements.

Engineering Department

The design of all projects should include the necessary facilities to provide a waste effluent which when diluted in the stream will not cause nuisance or damage, and will meet with the approval of the control agency in the area where the project is to be built. The necessary state permits are usually obtained by this department. In dealing with state control authorities it will be found that these men are either technically trained or have the benefit of advice from objective technical men. This results in a spirit of reasonableness and cooperation and a willingness to meet industry halfway. In connection with all site surveys and plant expansions, waste disposal limitations should be determined and made known to the officials responsible for the final selection. Consulting service should be provided for plant organizations and other company departments.

Medical Department

When a question of toxicity to human beings becomes a problem, the medical department should accumulate evidence and set the limiting concentrations. At the River Rouge plant of the Ford Motor Company, the Medical Department is responsible for the water and waste laboratory which not only makes analyses but also carries

out waste surveys and initiates research projects. It represents the company at conferences and discussions of technical problems with any of the governmental health authorities.

Public Relations Department

The public relations department should be well informed on its company's waste activities so that it can participate in all public relations aspects of the pollution abatement program. In the development of two new du Pont plant sites, for example, the company has recently received letters from local citizens inquiring about the probable influence of the plant wastes on the local streams. In each case, due to prior planning and conferences with state authorities, assurance could be given that no damage would result from the proposed operations.

Legal Department

Since the close of the war, state legislatures have been very active in promulgating new pollution control laws and providing funds for their enforcement. A member of the legal department designated to follow this activity will be able to advise interested personnel in the company of the new or changed laws.

Operating Department

In the final analysis, it is the operating department which has to nurse along the new process whether it be a lion or a lamb. The design effort has been to make it a lamb, but plant scale operations sometimes produce different results from those expected. A series of samples and analyses will have to be made to determine the actual waste characteristics.

Old operations may have fallen behind the advancing requirements of new laws, and it is the plant waste specialist's responsibility to investigate and recommend, if not decide, remedial measures. At a certain plant about 20 years old the wastes had never been seriously studied until recently. A technical man familiar with the processes was assigned the sole duty of recommending methods of waste reduction and treatment. After careful study and investigation, including sampling and analyses, he was able to save more than $70,000 per year by merely changing a few pipes and valves, and the operating procedure. Many instances of recovery equipment paying for itself in a year or two are well known, but profitable waste reduction methods must not always be expected.

Another function at each plant should be the maintenance of adequate records. When expansions are made, when new laws are based on wastes discharged as of a certain date, when false allegations are made, when process efficiencies are being calculated, when a study is required to determine the capacity of the stream to assimilate wastes, or when estimates are being made of the waste load expected from a new plant which happens to be similar to an existing plant, a long series of plant effluent analyses will be of great help.

Salvage and Reclamation Department

The waste products being washed to the sewers of a plant should be investigated at intervals for possible salvage value. With changing markets, new uses and cheaper recovery methods, some substances considered valueless in the past may be recovered at a profit. The fermentation industry is a recent example. The modern grain processing plant has been able to make a considerable profit by converting wastes to animal feed.

The du Pont Waste Control Organization

As an example of what has evolved in a company with many and varied industrial waste disposal problems, the du Pont Company organization and administration for the control of wastes will be described. The company, as

you know, is a large, diversified chemical concern. In the chemical industry the normal life of many processes seems to be notoriously short due to changing conditions and the advancements being constantly made in technological knowledge. This characteristic of the business continually creates new waste problems which must receive adequate attention. The organization contains ten operating departments, each of which maintains its own production and research organizations and is under a general manager reporting to an executive committee which in return reports to a board of directors. In addition, there are several auxiliary departments including chemical, engineering, public relations, legal, medical and service.

Company practice has established a policy which attempts to abate any water pollution that will cause nuisance or develop conditions failing to conform to prevailing regulations. To implement the policy, rules have been issued authorizing appropriation requests to be made for these purposes without regard to return on investment. Another rule requires that every project proposed must include a consideration of the necessary facilities for adequate disposal of waste.

With money available, the other important requisite is to have people in high enough administrative positions appreciate and understand the necessity for such work and see that it is given full consideration. This has been facilitated by the formation of a company Pollution Abatement Committee. Each operating department and the interested auxiliary departments are represented by one or more individuals who are sufficiently high in their particular group to influence decisions. These men meet five times a year to discuss current activities and pollution abatement both within and without the company. In addition to the meetings, new information on legislation, publicity, etc., is sometimes circularized by letter, and a company-wide compilation of investment in waste facilities has been made through the committee's efforts. The Engineering Department is responsible for coordinating the organization.

Within the Industrial Engineering Division of the Engineering Department, there is a small group of men who spend full time on waste disposal and pollution abatement problems. These men act as consultants to assist any other company group on request. Advice is given not only to individual plants, both large and small, but also to other divisions within the Engineering Department itself concerning design, plant expansions, plant site studies, evaluation of processes and permits. Assistance is also given by this group on public relations matters involving waste. Various members represent the company on technical committees of organizations such as the American Institute of Chemical Engineers and the Manufacturing Chemists' Association. The functions outlined above under the section on "Administration of Waste Control Program" are carried out by the appropriate department.

At most of the larger plants, one or more men spend full time in running continuous waste surveys, developing methods for waste recovery or treatment, and in educating personnel through talks and motion pictures. These men are usually engineers or chemists in the plant Technical Section or the Power and Water Operating Groups. It is sometimes convenient to have the work done under the plant engineer. These plants operate in the same manner as outlined for the medium-size company. At the smaller plants the procedure followed is similar to that outlined for a small company. The services of the Engineering Department waste consultants are available to the plant on request, or if desired, outside consultants may be called in. Many of the operating departments

transmit to their plant managers the information developed at the Pollution Abatement Committee meetings, which in turn keeps the small plant manager better informed.

Most plants have laboratories in which necessary analyses of the wastes and receiving waters can be made. If any locations are lacking in these facilities the service of an outside laboratory or that of the Chemical Department—which maintains general laboratories at headquarters in Wilmington—can be called upon to perform the desired tests. Where very specialized data are desired, such as the toxicity to fish of a certain compound, the services of outside research groups are sometimes enlisted. In connection with toxicity to human beings, the services of the company's Haskell Laboratory of Toxicology are always available.

It is apparent from this description that a company pollution abatement organization can become an extensive and costly undertaking, but there are worthwhile compensations to be derived from operating economies and in the furtherance of a company's objective to be a "good neighbor." The solution of all waste disposal problems is a goal not easily achieved. In the author's company there are many problems, some quite involved, the solution of which is still undetermined.

Conclusion

If industry is to meet its responsibility to the public for proper waste disposal and avoid haphazard and inefficient measures based on temporary expediency, it will in many cases be necessary for individual companies to review their policies and procedures for handling this important subject, and incorporate into their internal organization the necessary personnel and administrative provisions.

THE INDUSTRIAL PLANT WASTE DISPOSAL SURVEY *

By Roy F. Weston, Robert G. Merman, and Joseph G. DeMann

Respectively, Sanitary Engineer, Assistant Sanitary Engineer and Biologist-Chemist, Waste Control Laboratory, The Atlantic Refining Co., Philadelphia, Pa.

It is the primary objective of the industrial plant waste disposal survey to obtain basic information essential to the selection of adequate and economical pollution abatement procedures. The successful attainment of this objective is dependent on the point of view of management and responsible technical personnel, the administrative organization for handling pollution abatement activities and the technical approach to the problem. Although point of view and administrative organization may be just as important as technical approach in obtaining a "solution" to a pollution abatement problem, space will permit only a brief discussion of technical factors.

It has been found advantageous to conduct the plant survey in four basic steps. These are:

1. A comprehensive survey of the plant and the receiving stream to establish the basic pollution abatement problem.
2. Research investigations to devise abatement procedures or processes.
3. Development work to establish the applicability and economics of proposed methods.
4. Engineering surveys to define the layout and physical aspects of the existing plant pertinent to the selection of pollution abatement procedures.

In devising the pollution abatement program, an important basic concept which should be borne in mind at all times is that pollution abatement is not necessarily synonymous with waste treatment. That is, the abatement of pollution may be partially or completely accomplished by conservation measures, waste utilization procedures and/or process changes without providing waste treatment facilities. With the foregoing outline of procedures and basic concept it is possible to devise the detailed procedures of the program.

Comprehensive Survey

The comprehensive survey should include a quantitative survey of the characteristics and flow of the various plant effluents and of the receiving stream and, concurrently, a qualitative process survey of the plant to establish the type and location of the various sources of pollution. Then, detailed investigations should be made of trouble areas and troublesome processes.

The quantitative effluent survey should characterize waste quality relative to the following constituents: (1) suspended solids, (2) turbidity, (3) color, (4) oxygen consuming materials; that is, B.O.D. and/or C.O.D., (5) dissolved solids, (6) pH, alkalinity and/or acidity, (7) taste and odor, (8) immiscible liquids or floating solids, (9) temperature and (10) toxicity to aquatic life (7).

The above constituents have been selected on the basis of their effects on the cleanliness and usefulness of surface waters (1,2). The concentration of these constituents is the minimum that should be known about the waste and should be determined in all cases,

* Presented at 20th Annual Conference, Pennsylvania Sewage and Industrial Waste Assn., State College, August 25–27, 1948.

unless prior studies of similar plants have demonstrated that some of them are unimportant in the specific pollution problem. In some cases a more detailed knowledge of the wastes may be advisable, so that the above list should be expanded. If similar qualities, plus dissolved oxygen content, are determined on the receiving stream above and below the point of plant discharge, the relative pollution caused by the plant may be evaluated. Thus, the effluent survey, plus the stream survey, will yield information that may be considered in the light of governmental regulations or water quality requirements of downstream users to establish the basic pollution problem requiring correction. The information thus obtained provides a basis for inaugurating conservation measures, making process changes and installing waste treatment facilities.

The effluent survey is a very important phase of the pollution abatement program. The importance of this phase of the program justifies a general discussion of sampling apparatus and procedures, data organization and analysis techniques, flow measuring equipment and estimating methods, personnel and facility requirements.

The problem of sampling and the interpretation of data obtained on the sample is probably one of the most important aspects of the program. It is the objective of sampling to collect small portions of the waste water stream that are typical of the quality of the whole. Consequently, after the samples have been collected and their characteristics determined, it is presumed that such characteristics are typical of current conditions. Because relatively large investments may be involved in providing corrective measures, it is positively essential that the sampling procedures shall be sound.

Sampling Frequency

It has been customary to collect 24-hr. samples composited in proportion to flow. Such samples, if properly collected, stored and analyzed, may give a good picture of the characteristics of the wastes, using the day as the elementary unit of time. The 24-hr. composite sample has proven reasonably satisfactory for evaluating B.O.D. and solids loadings on streams and simple treatment devices, but it is questionable if the time period is sufficiently short for many types of industrial wastes.

It is known that gross industrial pollution of some types, for a time interval of one hour or less, can cause stream damage requiring a lifetime to restore. Obviously, in such types of pollution it is necessary to know what happens in shorter time intervals than 24 hours. In other cases, the variations within a 24-hr. period may overload treatment facilities so that satisfactory operation may be difficult to attain. In the case of both acid and alkali wastes, a 24-hr. composite sample may indicate a neutral waste, although hourly samples would indicate both highly acidic and highly alkaline characteristics. In addition to the several typical reasons given above, a statistical approach to the problem definitely indicates the advisability of collecting samples on a shorter time interval basis than 24 hours. Typical data showing the influence of sampling procedures on values obtained are shown in Figure 1. These data indicate that the 2-hr. composite gives more consistent values than the 2-hr. spot samples and a wider range of values than the 24-hr. composite. Such observations are reasonable and are to be expected. They indicate that short time composite samples will probably give the most reliable information. It has been found advantageous to collect a series of 24-hr. composite samples for complete analysis and then to collect a series of 2-hr. composite samples for the analysis of only those characteristics found to be most important.

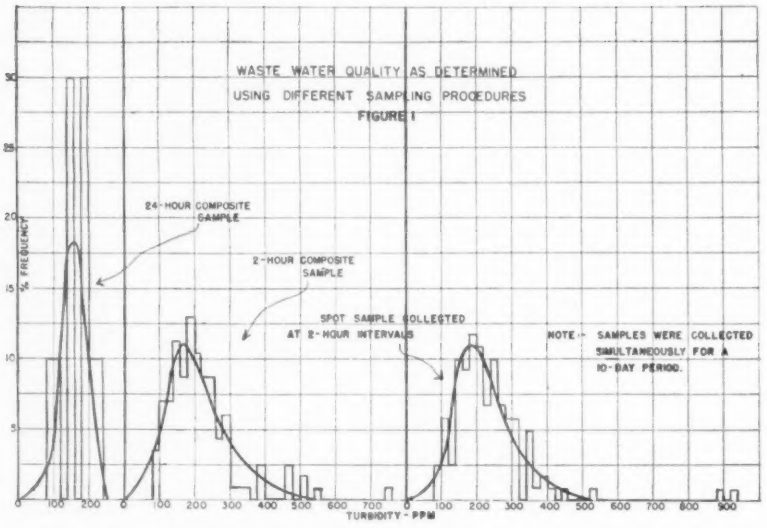

WASTE WATER QUALITY AS DETERMINED
USING DIFFERENT SAMPLING PROCEDURES
FIGURE 1
24-HOUR COMPOSITE SAMPLE
2-HOUR COMPOSITE SAMPLE
SPOT SAMPLE COLLECTED AT 2-HOUR INTERVALS
NOTE:- SAMPLES WERE COLLECTED SIMULTANEOUSLY FOR A 10-DAY PERIOD.
% FREQUENCY
TURBIDITY - PPM

FIGURE 1.—Waste water quality as determined by different sampling procedures.

Interpretation of Data

The interpretation of the data obtained is intimately associated with the method of sampling. It has been found convenient to organize the data in accordance with its frequency of occurrence as shown on the probability curve, Figure 2, and the histogram, Figure 3. If the factors influencing the character of a waste are numerous and of the same order of magnitude, the data should plot in a straight line on arithmetic probability paper and should plot as a normal frequency curve on the histogram. If, on the other hand, the factors influencing waste quality are few in number, or if one or two factors are large in comparison with all others, the data may be expected to give a skewed distribution, as shown on the histogram, Figure 3, and may plot as a straight line on logarithmic probability paper, as shown on Figure 2. By plotting sample quality versus time, it is possible to determine whether or not there are cycling occurrences that may influence distribution. Such occurrences will tend to give skewed distribution. Random occurrences should tend to give normal distribution.

The statistical approach makes it possible to estimate average conditions and the normal variations in quality that may occur. It is also possible to determine the confidence that may be placed in any mean value or variance of a given number of samples, or it is possible to estimate approximately the number of samples required to give the desired limits of confidence in the sample value obtained.

Adequate data and the proper analysis of the same makes it possible to estimate average conditions and the extremes for which design may be necessary. It also makes it possible to evaluate process and waste disposal practice within the plant, and to determine the desirability of making process changes or installing waste treatment facilities. The application of statistical methods to analyzing such problems provides a valuable aid to judgment. In the future much will be heard about the application of statistical techniques to waste disposal problems.

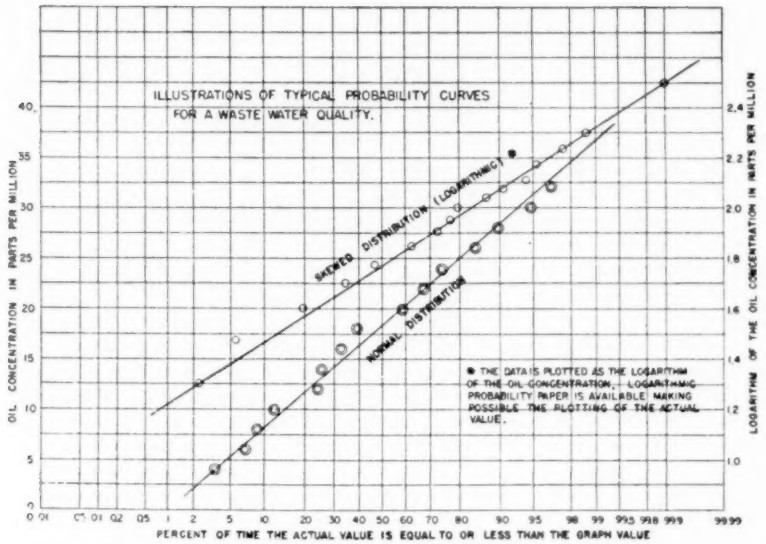

ILLUSTRATIONS OF TYPICAL PROBABILITY CURVES
FOR A WASTE WATER QUALITY.
SKEWED DISTRIBUTION (LOGARITHMIC)*
NORMAL DISTRIBUTION
* THE DATA IS PLOTTED AS THE LOGARITHM OF THE OIL CONCENTRATION. LOGARITHMIC PROBABILITY PAPER IS AVAILABLE MAKING POSSIBLE THE PLOTTING OF THE ACTUAL VALUE.
OIL CONCENTRATION IN PARTS PER MILLION
LOGARITHM OF THE OIL CONCENTRATION IN PARTS PER MILLION
PERCENT OF TIME THE ACTUAL VALUE IS EQUAL TO OR LESS THAN THE GRAPH VALUE

FIGURE 2.—Illustrations of typical probability curves for a waste water characteristic.

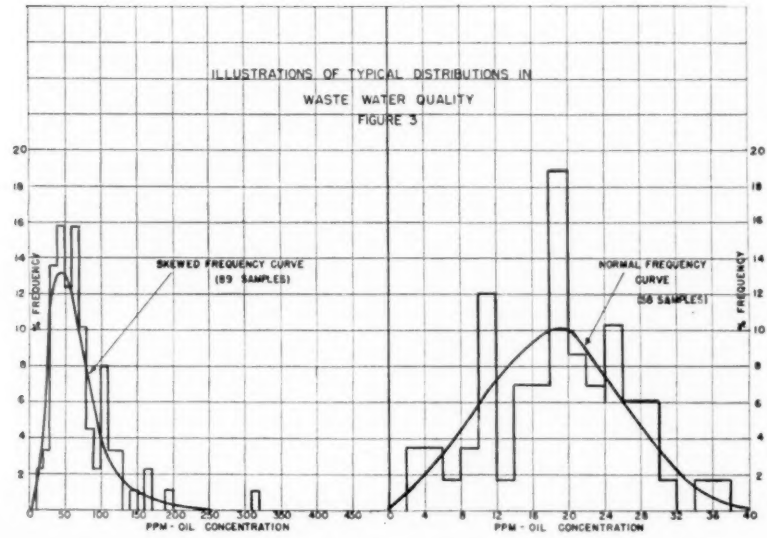


FIGURE 3.—Illustrations of typical distributions in waste water quality.

Sampling Techniques and Equipment

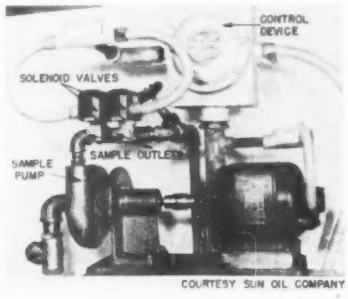
Sampling techniques and equipment will also influence the validity of data. In general, the flow conditions in the sewer will assure good mixing of water-soluble or colloidal materials so that the waste quality will be uniform from point to point within the sewer. This is not true of settleable and floating materials. In the case of such materials, special techniques and equipment may have to be used to allow for the distribution of concentration with depth of flow. The sampling technique and the equipment involved will depend on the specific problem, so it is impractical to attempt a detailed discussion of the subject at this time.

Various sampling devices are available for collecting both continuous and spot samples. The continuous sampler obviously collects the more typical sample, so it is recommended for most cases. Two practical and acceptable types of automatic samplers are those employing a rotating scoop or a time-cycle-operated solenoid valve (9). In either type of sampler it is possible to provide control mechanisms so that the quantity of sample collected is directly proportional to the metered rate of waste water flow. The rotating-scoop type of sampler is probably more reliable for waste waters containing large quantities of suspended solids. A homemade sampler of each type is shown in Figure 4.

In the case 24-hr. composite samples are to be collected of oxygen-consuming wastes, the sample container should be stored under refrigeration. If samples are to be collected for the determination of oil, a separate container should be used for that analysis. In any sampler installation, considerable thought should be given to the location of the sampling point or points. This is important because it must be remembered that the reliability of the analytical data is no better than the accuracy of the sample.

Sampling procedures using a single inlet and a centrifugal pump for sample collection are recommended for soluble or colloidal waste materials. Spe-

ROTATING SCOOP TYPE



SOLENOID VALVE TYPE

FIGURE 4.—Two types of automatic samplers.

cial sampling procedures may have to be used for settleable solids and floating materials.

It is important that the activities within the plant should be known at the time of sampling. If major units are down or if major products are not in the process of manufacture, the effect of these units or operations must be considered in analyzing and interpreting the data. Seasonal variations in waste water quality may be a big factor in some plants, so that samples will need to be collected at the time of each seasonal operation. In any case, an effort should be made to collect samples so as to obtain a typical cross-section of the waste quality.

Flow Measurement

An accurate estimation of flow and its variations is just as important as an accurate estimate of waste water quality. Numerous devices are available for flow estimation. They include rectangular, triangular or broad-crested weirs, Venturi flumes, nozzles, orifices and others (3). Continuous recording devices are available for such facilities. Submerged weirs may be used to advantage in some cases of low available head (4). Bentzel velocity tubes or floats may be used advantageously for determining spot rates of flows in sewers. In some cases salt solutions or radioactive materials may be used along with appropriate feeding devices and instruments for estimating spot rates of flow or for continuous flow records. Obviously, continuous records are much superior to intermittent or spot records and should be used in practically all cases. It is essential that the flow data be correlated with the sample analytical data.

In many plants both process drainage and storm water drainage are handled in a single, combined sewer system. Depending on the type of plant involved, it may be necessary to treat a portion or all of the storm water drainage in addition to the dry weather flow. In practically all cases the installation of storm water overflow or by-pass facilities will be required. Consequently, it will be necessary to estimate storm water flow. The use of continuous flow records on the plant effluent affords an excellent opportunity to obtain data for making estimates of runoff. A continuous flow record makes it possible to develop a "unit hydrograph"[1] for the area under study (5). Such a hydrograph reflects the detailed storm water runoff characteristics of the area involved and probably affords the most satisfactory means of estimating the flow for "design storms." Rainfall data are essential to the use of the unit hydrograph principle. Although a continuous record of local origin is preferable, fractional hourly data from the most simple type of rain gauge may be satisfactory. Using local rainfall and runoff data, it is possible to determine rainfall losses or runoff coefficients for the area and to determine the hydrograph characteristics.

Analysis of rainfall and runoff data to determine a "unit storm"[2] and a "unit hydrograph" will make it possible to use such data in the synthesis of a hydrograph for a "design storm." In estimating a "design storm"[3] of one, five, ten or more years frequency, the Department of Agriculture Miscellaneous Publication No. 204 has proven to be most helpful (6). A comparison of an actual hydrograph with a synthesized hydrograph derived from a

[1] The "unit hydrograph" is the hydrograph of surface runoff from a given area, due to excess rainfall for a unit of time. The unit of time should be ¼ to ⅓ of the runoff concentration time for the area.

[2] A "unit storm" is any storm occurring in the interval selected for the "unit hydrograph." The commonplace storm will usually be made up of one or more "unit storms."

[3] A "design storm" is a rainfall of the duration and quantity of precipitation for which it is considered advisable to design. Usually it will include more than one "unit storm."

"unit storm" and a "unit graph" is shown on Figure 5.

Flow data on the receiving streams may be obtained from U. S. Geological Survey or State Geological Survey stream flow data. If such is not available locally it may be possible to estimate flows based on total drainage area and data from upstream stations. In the event of small streams on which there are no data available, it may be possible to install standard flow measuring stations at relatively low cost.

Process Survey

It is desirable to conduct a qualitative process survey concurrently with the effluent and stream surveys. It is the purpose of this procedure to establish each and every source of waste, to describe its general characteristics and probable constituents, and to estimate roughly its quantity and frequency of occurrence.

With such data, it is possible to classify the wastes originating in the plant as to type and to locate their source on a plant map. Such a map has proven to be of considerable value in designing survey programs, in defining the practicability of the segregation and collection of similar wastes, in determining treatment plans, and in explaining and justifying various proposals.

On the basis of data on the characteristics of the plant wastes and the qualitative process survey it is possible to determine the several areas or units in need of more detailed investigation. Then, quantitative data on waste water qualities and flow rates can be obtained as needed to definitely define the local problem. Thus, by an organized procedure, data are obtained to define the

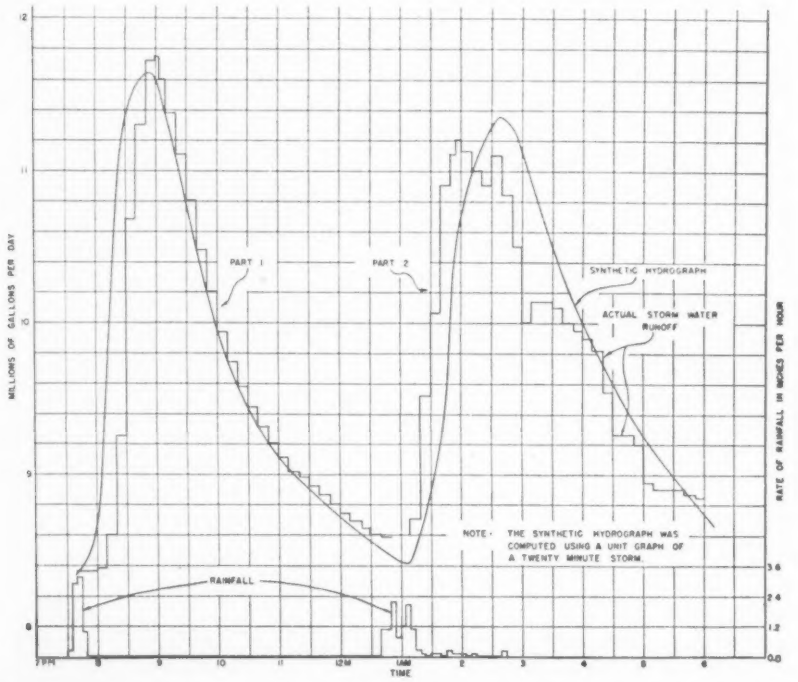

MILLIONS OF GALLONS PER DAY
RATE OF RAINFALL IN INCHES PER HOUR
PART 1
PART 2
SYNTHETIC HYDROGRAPH
ACTUAL STORM WATER RUNOFF
NOTE: THE SYNTHETIC HYDROGRAPH WAS COMPUTED USING A UNIT GRAPH OF A TWENTY MINUTE STORM.
RAINFALL
TIME

FIGURE 5.—A comparison of actual storm water runoff with a synthesized hydrograph.

plant problems, local area problems, and, finally, unit problems. With such a background of information it is possible to proceed with the program to arrive at a practical and economical solution.

Research and Development

No adequate waste disposal survey is complete without research and development work. A study must be made of the prior art. Various test tube or table top investigations are essential and pilot plant work is highly desirable. Although relatively little has been published concerning industrial wastes, a survey of English language literature alone will reveal some references concerning almost every major problem. Literature on waste disposal practices may be found in numerous places. It is indeed fortunate, however, if an organized bibiliography is available.

In addition to a review of the prior art in waste disposal, it may be necessary to investigate the process literature to determine the possibilities of pollution abatement by process change. This is generally the most satisfactory solution to such problems, if feasible. Consequently, such possibilities should be investigated most thoroughly because without a doubt the best solution to a waste disposal problem is to eliminate the waste.

In some cases, waste utilization procedures may be practical. Generally, industrial technicians have already provided by-product recovery processes for all those wastes which may be recovered at a profit. Consequently, it is rare that a waste disposal survey will reveal an obvious need for recovery and/or utilization measures. However, the need for waste disposal alters the economics of waste recovery and utilization. It may be justified on the basis that it is the most economical method for abating pollution, although it does not make a profit for the industry. A number of factors, such as the reliability of the source of materials, the market requirements and trends, the technical trends in processing, the control of patents, the available technical service and sales organizations, in addition to convenience, risk and first cost, may all influence the final decisions (8). Therefore, utilization may not be advisable, although possible. The process literature should nevertheless be reviewed with the thought in mind that waste recovery or utilization is a possibility.

Although a review of the prior art is essential, it should be used only as a guide to the solution of the local problem. Frequently, generalized published information describes only the obvious problems of an industry and recommends corrective measures to solve only those particular problems, although others may require attention.

There is generally more than one way to solve a problem. The possibilities and probable economics of different methods should be tested in the laboratory. Preliminary investigations that are well organized but unencumbered by refinement will generally indicate the possibility of success of a process. If success seems probable, experiments may be designed to demonstrate the influence of the various variables of treatment or processing.

In research work, as well as sampling, the statistical approach to the problem is advisable. A fundamental understanding of the theory of statistics will make it possible to design experiments so as to obtain the maximum information with the minimum of effort. The statistical approach to research problems is particularly advantageous because it necessitates a thorough analysis of the variables of the problem and it provides the ways and means of estimating the reliability of the results. Mathematical "tests of significance" aid in classifying differences in results obtained by various treatment methods as due to chance or to real and inherent variations in treat-

ment. Excellent sources of material for assistance in the design of experiments include "The Design of Experiments" by R. A. Fisher, and "Industrial Experimentation" by K. A. Brownlee.

Pilot Plant Studies

If the investment for waste disposal is relatively large, or if the process to be used is new, pilot plant investigations are essential. Extrapolation from test tubes, beakers and flasks to full scale facilities is generally too large for a safe basis of design. Consequently, semi-works size installations should be tried to test the practicability and economics of the proposed procedures under plant conditions.

If the variables of operation are many and the investment large, the facilities should be provided in duplicate. Duplicate facilities are highly advantageous because, in most cases, the variations in waste water quality are so great that it is practically impossible to evaluate differences in treatment procedures unless comparisons are available on the identical waste. Even in the case of duplicate units, experience has demonstrated that small differences in operation efficiency cannot be established as "significant" unless a large number of runs are available for comparison.

In pilot plant work also the statistical approach to the problem is most valuable, if not essential. Sampling procedures for determining pilot plant efficiencies are most effective when 1- or 2-hr. composite samples are collected in the place of the customary 8- or 24-hr. composites. A proper analysis of the pilot plant operation data affords a sound basis for estimating treatment efficiencies, variables of operation, accumulation of by-products and other valuable information.

Physical Plant Survey

The physical lay-out of the plant determines to no small extent the most economical procedures and equipment for abating pollution. Consequently, engineering survey information should be made available. Such information should include scale drawings of the plant showing roads, structures and all utilities, including sewers, water, steam, air, gas and power, and significant elevations. Information should also be available to indicate subsoil conditions and ground water levels.

With plant and stream survey data, a background of the prior art, research and pilot plant information and engineering knowledge, it is possible to select adequate and economical pollution abatement procedures.

Personnel Requirements

The personnel required to conduct the investigations described above should be well trained in the appropriate phases of engineering, chemistry and biology. Although the engineer must determine the information required and must make the ultimate decision for the solution of the problem, he is dependent on the chemist and biologist for a large part of the basic data essential to a sound decision. The increasing importance of biology in evaluating pollution problems and the general use of biological treatment procedures indicate a need for a chemist with a strong biology background, or vice versa, in all pollution abatement organizations. Large organizations can well afford specialists in both branches of science.

Although the technical aspects of pollution abatement are no more complex or difficult than many other phases of industrial activity, a specialized background of training and experience in the field is a practical necessity. The only reasonable substitute for appropriate training and experience is a very good general technical background supported by both initiative and sound judgment. It has been found that high caliber non-technical personnel can be trained for both field and lab-

oratory activities. A ratio of two non-technical men to one technical man is the maximum recommended.

A breakdown of man power requirements for analytical work is presented in Tables I and II as an aid to the selection of personnel for a predetermined program.

Experience in several plants has demonstrated that water analysis work should be assigned to a single individual and that he and those permanently assigned to work with him should have space and apparatus that are independent of the other laboratory activities.

Application of the Survey

As previously stated, pollution abatement does not necessarily mean waste treatment. The possibility of pollution abatement by other means should be borne in mind while conducting the plant survey. Consequently, several possibilities that may aid in providing an economical solution to the problem are summarized as follows:

TABLE I.—An Outline of Personnel Requirements for Various Analytical Programs

Analytical Determination	Method of Analysis	Dilutions for Each Test	Time Required to Analyze One Sample (Min.)	Time Required to Analyze Two Samples (Min.)	Assignment of Analyses			
					Schedule No. 1 One Sample	Schedule No. 2 Two Samples	Schedule No. 3 One Sample	Schedule No. 4 Two Samples
Alkalinity-Acidity	Volumetric	2	8	15	C	A	U	U
pH	Electrometric	1	5	8	C	A	U	U
Suspended Solids	Gravimetric	1	15	18	C	C	A	A
Turbidity	Colorimetric	2	15	20	C	A	U	U
Color	Colorimetric	1	20	28	C	A	A	A
Odor	Sensory	1	20	25	C	A	C	A
B.O.D.	Volumetric	3	70	105	C	C	C	C
C.O.D.	Volumetric	2	30	60	C	C	C	C
Dissolved Oxygen	Volumetric	1	4	7	C	A	U	U
Total Dissolved Solids	Gravimetric	1	15	20	C	A	A	A
Toxicity to Fish	Bio-assay	3	90	120	C	C	C	C
Temperature		1	2	3	C	A	U	U
Total Hardness (calcium and magnesium ions)	Volumetric	1	25	35	—	—	U	U
Chlorides	Volumetric	1	10	15	—	—	A	A
Sulfates	Volumetric	1	24	30	—	—	A	U
Specific Cond.	Electrometric	1	10	13	—	—	U	U
Iron	Colorimetric	2	40	50	—	—	A	A
Oil or Grease	Volumetric	1	30	35	C	A	C	A
Phenol	Colorimetric	2	35	50	—	—	C	A
Sulfides	Colorimetric	1	5	8	—	—	U	U
Total Org. Nitrogen	Colorimetric	2	30	40	—	—	A	A
Ammonia	Colorimetric	2	12	18	—	—	A	U
Nitrite	Colorimetric	2	15	21	—	—	A	U
Nitrate	Colorimetric	2	24	35	—	—	A	U
Phosphorus	Colorimetric	1	20	26	—	—	A	A
Chlorine Demand	Colorimetric	1	25	35	—	—	A	A
Ammonia by Dist.	Colorimetric	2	25	32	—	—	A	A
Silica	Colorimetric	2	20	28	—	—	—	—
Copper	Colorimetric	2	20	28	—	—	—	—
Chromium	Colorimetric	2	30	35	—	—	—	—
Aluminum	Colorimetric	2	25	30	—	—	—	—

TABLE II.—Summary of Time Distribution—Laboratory Personnel

Personnel	Schedule No. 1 (man-hours)	Schedule No. 2 (man-hours)	Schedule No. 3 (man-hours)	Schedule No. 4 (man-hours)	Remarks
1. Chemist:					"C" = Chemist-Biologist
Testing	5.4	5.2	4.6	4.8	"A" = Laboratory Assistant
Miscellaneous Duties	2.6	2.8	3.4[1]	3.2	"U" = Utility Man
2. Laboratory Assistant:					Schedules 1 and 2 include the minimum number of tests recommended.
Testing	—	2.5	4.6	6.2	
Miscellaneous Duties	—	5.5[1]	3.4[1]	1.8	Schedules 3 and 4 include a series of tests on which time data was available.
3. Utility:					
Testing	—	—	0.75	3.7	Miscellaneous duties include:
Miscellaneous Duties	—	—	3.25	4.3	1. Preparing reagents.
					2. Ordering materials.
					3. Compiling reports.
					4. Supervision.
					5. Glassware washing.

[1] More time has been allotted than the essential minimum.

1. Elimination of wastes or change in waste characteristics by recovery or utilization, process change or changes in operation routine.

2. Reduction in the quantity of waste by conservation measures, good housekeeping, operation control and those procedures listed under No. 1 above.

3. Segregation of different types of wastes and/or the separation of wastes from clean water by the use of separate sewer systems. This may also include the separation of storm water flow from process flow or the use of cooling towers to reduce the quantity of water to be treated.

In addition to the above, relatively small local plants may be installed for treating concentrated wastes, or storage and compositing facilities may be provided for controlling the discharge of wastes so as to reduce the requirements of general treatment.

In view of the relatively large expenditures involved in the adequate abatement of pollution, it is advisable to organize the plant program and to select abatement procedures with an eye to the protection of that investment. The assured increase in pollution due to increases in population and industrial expansion, the increasing emphasis on the importance of sanitation in public health matters and the greater interest in the use of waters for recreation all point to the advisability of selecting abatement procedures with due consideration of the probable more highly restrictive requirements of the future. The tentative status of existing standards and requirements give credence to such a policy.

It is important that the procedures selected shall provide treatment 100 per cent of the time. The installation of facilities that require the by-pass of untreated wastes at times of emergency or routine shutdown may nullify the accomplishments of months of assiduous operation of expensive equipment. Plant expansion or process changes may overload treatment facilities so as to reduce efficiency or may make the procedures provided ineffective. Consequently, the selection of abatement equipment should be made on the basis of its adaptability to expansion and change.

In any case, administrative routine should make possible the study of the effect of process additions or changes

on pollution abatement at the time of the development of such plans. Recommendations made at that time may reduce trouble and expense after installation. Due consideration of these factors at the time of conducting the plant survey may aid in obtaining the most useful information.

The foregoing paragraphs have outlined, in a general way, an approach to the proposition of obtaining basic information to solve a plant waste disposal problem. The discussion has presupposed the desirability and need of a comprehensive program to assure the most economical course. Obviously, the amount of investigational research and development work carried out must be governed by the magnitude and complexity of the problem. The authors know of no pollution abatement problem, large or small, that does not warrant comprehensive study to assure the fact that the money to be expended will economically accomplish the objective for which it is spent.

References

1. Weston, R. F., "Fundamentals of Water Pollution for Industry." THIS JOURNAL, **20**, 682 (July, 1948).
2. Hart, W. B., "Standards for Industrial Waste Treatment and Disposal." Presented before Pennsylvania Chemical Society, March 26, 1948.
3. King, H. W., "Handbook of Hydraulics." McGraw-Hill Book Co., New York.
4. Vennard, J. K., and Weston, R. L., "Submergence Effect on Sharp-Crested Weirs." *Engineering News-Record*, June 3, 1943.
5. Meinger, O. E., Editor, "Physics of the Earth, IX. Hydrology." McGraw-Hill Book Co., New York.
6. Yarnell, D. L., "Rainfall Intensity-Frequency Data." Miscellaneous Publication No. 204, U. S. Department of Agriculture (1935).
7. Hart, W. B., Doudoroff, Peter, and Greenbank, John, "The Evaluation of the Toxicity of Industrial Wastes, Chemicals, and Other Substances to Fresh-Water Fishes." Bulletin of Waste Control Laboratory, The Atlantic Refining Co., Philadelphia, Pa.
8. Weston, R. F., "The Waste Disposal and Utilization Problems of the Petroleum Industry." *Proceedings*, First Industrial Waste Utilization Conference, Purdue University (1944).
9. "Disposal of Refinery Wastes." Publication of the American Petroleum Institute, New York, N. Y. (in press); "Trebler Sampler," Bulletin 130, Lakeside Engineering Corp., Chicago; "True-Test Sewage Sampler," Bulletin 155, Chicago Pump Co., Chicago.

EXPERIMENTS ON ANAEROBIC DIGESTION OF WOOL SCOURING WASTES *

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In the summer of 1947 the city of Lebanon, Tenn. made certain investigations for the purpose of determining the feasibility of treating the industrial wastes from the Lebanon Woolen Mills at the existing city sewage treatment plant and to determine what additions or alterations at the plant might be necessary for this purpose.

The city sewage treatment plant is of the separate sludge digestion, trickling filter type with provisions for applying chemical coagulants and flocculation ahead of the primary clarifier. The plant was designed for a capacity of 800,000 g.p.d. and is now treating a dry weather flow of between 500,000 and 600,000 g.p.d.

Volume and Character of Wastes

The Lebanon Woolen Mills manufacture woolen blankets. The wastes from this plant at the time of the investigations made under the direction of the author consisted of the usual dyeing, washing and finishing wastes, together with the waste from the wool scouring process. The total volume of waste from the mill is about 300,000 g.p.d. This included about 2,500 g.p.d. of wool scour waste at the time of the investigation. The volume of wool scour waste varies from 2,500 to 10,000 g.p.d. depending upon the amount of grease wool being scoured.

Color did not seem to be a problem as it was well dissipated when equalized and mixed with the cloth washing waste. The studies indicated that with certain modifications and additions to the plant, the equalized combined wastes other than the wool scour wastes could probably be successfully treated in combination with the city sewage. It is anticipated that plant scale experiments with this in view will be conducted at an early date.

Wool scour waste has always been considered a difficult waste to treat by ordinary processes, due primarily to its high grease content. It will be possible to determine its effect on the trickling filter in this particular case after the mill waste is connected, but it was anticipated from the start that some pretreatment of the wool scour waste for degreasing would be necessary before discharge into the city sewer.

When scouring the maximum volume of grease wool the volume of waste from the scouring process at this mill is about 10,000 g.p.d. The wool is scoured in the usual train of scouring bowls in a scouring solution of alkali and soap. The waste is a brown thick turbid liquor, in the nature of an emulsion in which the grease and organic matter removed from the wool is highly dispersed and remains in suspension. It contains some settleable mineral solids, but the greater portion of such solids is removed by a dusting operation before scouring.

The strength of the waste varies depending upon the pounds of wool scoured in the bowls before the scouring solution is dumped. The range of

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data from a number of analyses at this mill is as follows:

Total Grease (p.p.m.)	8,000 to 14,000
pH	8 to 9.6
5-day B.O.D. (p.p.m.)	5,000 to 14,000
Total Solids (p.p.m.)	25,000 to 65,900
Volatile Solids (p.p.m.)	18,000 to 41,000

Treatment Methods Considered

Most of the published literature on the subject states that biological processes of treatment are not applicable to the treatment of wool scour waste, due primarily to the high grease content. It is generally stated that the grease must be removed from this waste before any type of treatment is applied.

Faber (1) has recently described a new process, known as the Hypochlorite Process, involving the use of calcium hypochlorite as a coagulant followed by acid treatment of the resultant sludge and scum for grease recovery.

It might also be of interest to mention here that Smith-Drum and Company of Philadelphia have been developing, over a period of years, a process and a machine for the degreasing of wool by means of a synthetic solvent. This process is not being developed as a process of waste treatment but rather as a process of scouring wool, but it would seem that the waste treatment problem from such a process would be simplified. The wool would be degreased prior to washing in plain water in the standard scouring bowls to remove the remaining water-solubles and solids. The process involves degreasing the wool by the use of a synthetic solvent, the solvent being reclaimed for re-use by distillation and the solids, including the grease, which are removed by the solvent are recovered in a dry form. One large machine is now being installed for trial on a production basis and a second machine is under construction.

Where treatment has been required in the past the usual method recommended for treating this waste has been to remove the grease by "acid cracking." By this method relatively large volumes of sulfuric acid are used to acidify the waste, after which the grease is removed as sludge or scum and may be processed for grease recovery.

Experiments carried out under the direction of the author with "acid cracking" of this particular waste gave inconsistent results, and at best it seemed it would be an odorous, messy process requiring careful control to obtain a satisfactory percentage of grease removal. The volume of the waste involved was small and variable, and neither the owners nor the city officials desired to undertake the recovery and sale of grease as a part of the process of treatment due to the operating problems involved.

Despite the fact that investigators have definitely stated that wool scour wastes could not be treated by biological methods, the success reported in recent years in the rapid digestion of other types of strong trade wastes by "Controlled Digestion" procedures, developed by Buswell and Boruff (2) and reported upon by Buswell and Schlenz (3), gave rise to the decision to experiment with the destruction of wool scour greases by such controlled digestion methods.

It appeared logical that if the digestion of the waste could be controlled by following the procedures established for the successful handling of other wastes as outlined hereinafter, the high content of grease in the wool scour waste could be greatly reduced.

That grease and soaps could be completely digested to form methane and carbon dioxide was shown in 1927 by Neave and Buswell (4). They demonstrated that gas yield was practically proportional to grease content of sludges studied. These results have later been confirmed by Rudolfs (5) and other investigators.

Laboratory Digestion Studies

The digestibility of this particular waste was first established by setting up a 5-gal. bottle sample at room temperature. The sample was seeded with digested sludge. Gas formed almost immediately and at the end of a 30-day period the volatile solid content was reduced about 60 per cent. The bottles were allowed to stand 7 weeks. At this time analyses indicated a volatile solid reduction of about 75 per cent and the 5-day B.O.D. dropped from 8,600 p.p.m. to 1,010 p.p.m. There was no separation of the grease from the liquid to form a serious scum problem and the settled sludge by observation was but little more than the seed sludge added.

The over-all results from these laboratory scale studies seemed to justify a further study of "Controlled Digestion" methods following the procedures reported by Buswell and Schlenz (3). They state that "Anaerobic fermentation has long been recognized as the least expensive method of removing organic matter, carbon and hydrogen from sewage or waste liquors where conditions are suitable for its application. The limit for practical application of anaerobic fermentation appears to be in the range of 1 per cent organic matter or more. This includes the sludge resulting from primary sedimentation. When the concentration is very much below 1 per cent, the amount of liquid required to carry the optimum solids loading becomes so great that the economies of the process disappear." Many trade wastes including wool scour wastes contain a concentration of organic matter considerably above the 1 per cent value.

The process involves two-stage digestion with means for positive temperature control and recirculation, both for mixing in the primary stage and for pumping supernatant from the secondary to the primary stage for control of the volatile acid content.

Volatile acids control has been employed successfully to foretell the approach of retarded digestion conditions at a number of municipal and trade waste installations where digesters are operating at higher loadings than those normally encountered in domestic sewage treatment practice. In fact, to digest most trade wastes successfully it has been found necessary to practice volatile acids control. This involves a simple determination which may easily be made daily to provide a "warning" long before a change of pH, alkalinity, drop in rate of gas production, or "foaming" conditions would indicate that trouble is at hand. This control method is described more completely in an article by Schlenz (6), who states that:

"In practice, if the volatile acids determination indicates a concentration of, say, 2,000 p.p.m. in a digester sample, or if succeeding determinations indicate a continued rise in the concentration of volatile acids, either of the following steps must be taken: (1) reduce the loading of raw solids in the digester showing the increase by diverting some of the raw solids to another digester in the system, or (2) circulate lower volatile acid content material from a second stage digester to the overloaded primary digester. As a result of such circulation a more rapid gasification takes place and the volatile acids are reduced much more than can be accounted for by mere dilution."

Pilot Plant Studies

A pilot plant was set up as shown in Figure 1. Two 500-gal. tanks were provided, equipped with hopper bottoms, gas collection domes and a small gas meter. Heat was first provided with hot water jackets on the recirculating pump discharge and, finally, for better regulation of temperature, the tanks were insulated and strap-on electric hot water tank heaters were installed which could be controlled thermostatically.

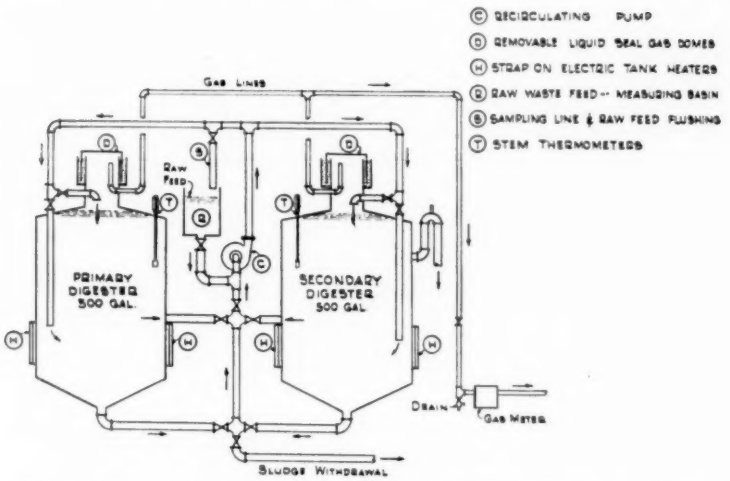

FIGURE 1.—Diagrammatic layout of pilot plant for digestion of wool scouring wastes.

The Lebanon Woolen Mills secured the necessary equipment for laboratory tests on volatile solids and volatile acid content. The State Board of Health cooperated with the mill in setting up these tests, and the work was done under the direct supervision of Mr. J. O. Wauford of the Lebanon Woolen Mills.

After the pilot plant was complete, 250 gal. of digested sludge was obtained from the city sewage plant and placed in the primary digester. Both tanks were then filled with water and the temperature raised to 95° F. The addition of wool scour waste was begun on August 1, 1947, 5 gal. being added the first day and this daily volume increased by increments over a 2-week period until on August 15 the feed was 36 g.p.d., which is equivalent to 0.06 lb. of total volatile solids (dry weight) per cubic foot of total digester capacity per day. Volatile acid tests were made daily and the volume of gas produced was checked daily.

The results of the laboratory tests are shown in Figure 2. The tests on volatile solids in the raw feed were not made daily, but from observations made prior and subsequent to the starting of the tests it was apparent that the volatile solids content averaged about 28,000 p.p.m.

A feed of 36 g.p.d. was continued from August 15 until August 23, at which time there was a sudden rise in the volatile acid content to about 4,000 p.p.m., indicating that the feed had been increased too rapidly. The feed was reduced to about 15 g.p.d. through the following week, but the volatile acid content increased to about 5,000 p.p.m. City water was added to the primary digester for diluting purposes. This had the effect of reducing the volatile acid content to below 2,000 p.p.m., and no further trouble was experienced in controlling the volatile acid content during the experiment.

From the start of the operation the volatile solids content of the overflow from the secondary tank increased with the added feed until August 21. After this it leveled off to between 5,000 and 6,000 p.p.m.

Gas formation was noticed within a

few days after the pilot plant was started in operation and by September 1 was between 30 and 40 cu. ft. per day.

At about this time there was a change in the type of product manufactured at the mill. With the change in product it appeared advantageous to purchase scoured wool. There was a certain amount of grease wool in stock and the scouring of wool was continued for the express purpose of continuing the digestion experiments. Due to the limited amount of wool on hand, how-

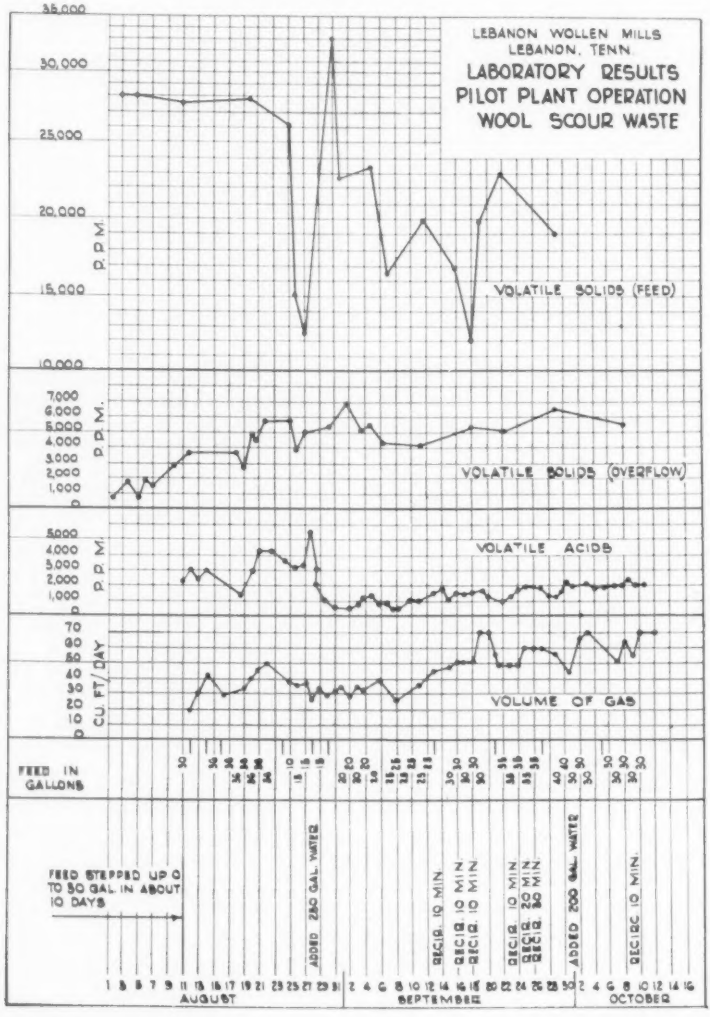

FIGURE 2.—Laboratory results of pilot plant operation on digestion of wool scouring wastes.

ever, the quantity of wool scoured per shift before dumping the bowls was reduced and this, of course, reduced the strength of the waste. The volatile solids content of the feed became variable from day to day depending upon the amount of wool scoured. The operation was continued with the waste available through the month of September up to October 14.

During this latter part of the run tests made on the volatile solids content of the feed ranged from 12,000 to 33,000 p.p.m. and averaged about 18,000 to 20,000 p.p.m. over the period.

After September 1 the raw feed was 20 g.p.d. for the first week, 25 g.p.d. for the second week, 30 g.p.d. for the third week and 35 to 40 g.p.d. for the fourth week. The feed was dropped back to 30 g.p.d. during the two weeks operation in October.

No trouble was experienced during this period in keeping the volatile acid content below 2,000 p.p.m., although on 5 days during the period the operator recirculated from the secondary digester to the primary digester for short periods of time ranging from 10 to 30 min. on days when the volatile acid content approached 2,000 p.p.m.

The volume of gas from September 15 to October 10 averaged from 55 to 60 cu. ft. per day and ranged from 8.6 to 10.2 cu. ft. per pound of volatile solids added. Volatile solids in the digester overflow during this period averaged about 5,400 p.p.m., indicating some 65 per cent reduction in total volatile matter. Samples taken at the end of the run indicated a grease content of 1,000 p.p.m. in the overflow as compared to a number of analyses on the raw waste which ran from 8,000 to 14,000 p.p.m., or an average of 11,000 p.p.m., for an indicated reduction in grease of 91 per cent.

In any pilot plant of this type there are a few kinks to be straightened out before the plant operates as intended, and while attention was being given to these troubles the daily routine laboratory tests were not considered important. In the early stages of the run difficulty was experienced in maintaining a constant temperature, particularly over week-ends and at night, until the strap-on type electric hot water heaters were installed. With this system the temperature could be controlled quite efficiently. Also, some difficulty was experienced in obtaining accurate gas measurements. At times when the tanks were recirculated, the gas seals in the small gas domes were blown and were undetected for a time by the operator.

Despite the fact that the operating data are incomplete, since the experiments could not be continued to establish an ultimate volatile solids loading factor due to the change in operation of the mill, it is felt that the results should be of considerable interest and should justify further study and investigation along this line.

The Lebanon Woolen Mills are maintaining the pilot plant intact so as to have it available for further experiments when wool scouring is resumed.

In designing the pilot plant for these experiments it was anticipated that the wool scour waste would respond to digestion in two-stage tanks having a total displacement capacity of 20 days at a volatile solids loading of 0.1 lb. dry weight per cubic foot of total tank capacity per day. The results of the incomplete pilot plant experiments indicate that loadings of approximately this amount might be approached, once the operation is established under proper control. The feed was not carried above 35 g.p.d. except for 2 or 3 days. The 35 g.p.d. rate represented about 60 per cent of the feed required for a 0.1 lb. volatile solids loading.

The control of the volatile acid content at below 2,000 p.p.m. was accepted as the limiting factor during the period the pilot plant was in operation. No attempt was made to determine results

at a higher volatile acid content in the primary tank, although a slight rise in volatile acid content did not appear to affect the rate of gas production.

Discussion

From the results reported above it appears that "Controlled Digestion" as a means of treating wool scour waste might offer advantages since the first cost of the plant would not be excessive and the operating cost should be nominal, as compared with other known methods of treating this difficult type of waste. Where a particularly high degree of treatment is required the digester effluent could be further treated by chemical precipitation or by trickling filters, as the grease and soap content is largely destroyed, and the remaining waste would be amenable to economical treatment by chemical or biological processes.

The practical results from observation of the operation were rather surprising. A scum problem had been anticipated, but during the digestion process there seemed to be no tendency toward separation of grease in the liquor and the only scum found was a very light froth on the surface of the digester. As stated before, the wool had been dusted prior to scouring to remove as much mineral matter and other material as possible. It was surprising how little digested sludge was left in the bottom of the secondary tank after the 2½ months of operation. Only 2 or 3 gal. of settled sludge were drawn from the bottom of the secondary digester during the operation. During the whole period of operation the overflow from the secondary tank was allowed to spill directly on the ground near the pilot plant, without any attempt to pipe it away. The ground was of a porous nature and absorbed the liquor without any apparent deposition of solids or grease on the surface, or without any noticeable odors or attraction of flies. This in itself is evidence to the writer that quite a bit had been accomplished in the treatment of this difficult waste, and it is hoped that there will be an opportunity of continuing these studies at some future date.

Summary

A pilot plant consisting of two 500-gal. anaerobic digestion tanks connected in series was constructed and operated for 2½ months for the treatment of wool scouring wastes.

The wastes carried an average of 28,000 p.p.m. of volatile matter, including 11,000 p.p.m. grease, and had an average B.O.D. of 10,000 p.p.m.

Difficulties were encountered in obtaining a uniform quality and quantity of feed. The temperature fluctuated greatly during the first part of the run, and change in factory conditions made it necessary to discontinue the experiment before optimum conditions could be determined.

In spite of these handicaps the pilot plant was operated over a 3-week period with a loading of 0.06 lb. (dry weight) of volatile matter per cubic foot per day. The gas yield was from 8.6 to 14 cu. ft. per pound of volatile matter added, and there was obtained a 65 per cent reduction in volatile matter and a 90 per cent reduction in grease.

It is believed that with fully controlled operation the loading can be increased to 0.1 lb. of volatile solids per cubic foot per day for approximately a 20-day digestion period. The results actually obtained indicate that anaerobic fermentation presents a possible practicable solution to the problem of the treatment of wool scouring wastes.

References

1. Faber, H. A., "The Hypochlorite Process for Treatment of Wool Scouring Wastes and for Recovery of Wool Grease." THIS JOURNAL, **19**, 2, 248 (March, 1947).
2. Buswell, A. M., and Boruff, C. S., "Method of Producing Methane." U. S. Patent No. 1,990,523 (Feb. 12, 1935).
3. Schlenz, H. E., "Important Considerations in Sludge Digestion. Part I.—Practical Aspects." THIS JOURNAL, **19**, 1, 19 (January, 1947); also "Part II.—Microbiology and Theory of Anaerobic Digestion," by A. M. Buswell, *ibid.*, p. 28.
4. Neave, S. L., and Buswell, A. M., "Fate of Grease in Sludge Digestion." *Ind. Eng. Chem.*, **19**, 1012 (1927); and **20**, 1368 (1928).
5. Rudolphs, W., "Decomposition of Grease During Digestion, Its Effect on Gas Production and Fuel Value of Sludges." THIS JOURNAL, **16**, 6, 1125 (November, 1944).
6. Schlenz, H. E., "Controlled Digestion." THIS JOURNAL, **16**, 3, 504 (March, 1944).

FURTHER COMMENTS ON SPRAY DRYING OF SLUDGE

A communication received from Mr. John R. Downes, Supervising Engineer of the Joint Sewage Disposal Plant at Plainfield, N. J., points out that there is apparently some misunderstanding of the spray drying system used for sludge dewatering at the Plainfield plant, as discussed in the November, 1948, issue of THIS JOURNAL (pp. 1102–3). Mr. Downes offers the following statements to clarify the above report:

"1. There is not enough gas to provide for complete drying under local conditions.

"2. If the sludge is first dewatered to 80 per cent water (20 per cent solids), the drying operation becomes self-sustaining by virtue of the fuel value of the dried product.

"3. With sludge containing more than 80 per cent water, we have used as auxiliary fuel coal, pitch, and oil. We are presently using oil.

"4. There has never been either an explosion or a fire connected with drier operation. One fire on the operating floor broke out in an electrical instrument cabinet at night when the drier was not in operation. The second fire referred to was in an experimental vacuum filter plant 75 ft. from the drier.

"5. We use alum flotation to concentrate the sludge to 12 per cent to 15 per cent solids before spray drying. We have not gone in for vacuum filtration. One vacuum filter manufacturer experimented with the sludge but admitted that they could not compete with alum flotation.

"6. The dried product is not in pellet form. It looks like the contents of a household vacuum cleaner bag. It is sold for fertilizer on seasonal demand, otherwise it is burned in the drier furnace to maintain the drying process."

COMPRESSED YEAST WASTES TREATMENT *

III. Pilot Plant Digestion Studies

By Willem Rudolfs and Eugene H. Trubnick

Anaerobic digestion has been found to result in a high degree of purification of wastes from the manufacture of compressed yeast. Jensen (1) described a two-stage digestion plant, which produced removals of 56 per cent of total solids, 84 per cent of volatile solids, 86 per cent of organic nitrogen and 89 per cent of B.O.D., with the production of 7.2 cu. ft. of gas per pound of volatile matter added. The gas contained 35 per cent CO_2 and 5 per cent H_2S. Schlenz (2) reported on a treatment plant which, with a loading of 0.104 lb. solids per cubic foot of digester capacity per day, produced removals of 37 per cent of total solids, 50 per cent of volatile solids, and 90 per cent of B.O.D., with the production of 9.5 cu. ft. of gas per pound of volatile matter added. The authors (3) have reported the results of laboratory investigations which, with loadings of 0.17 to 0.49 lb. solids per cubic foot per day, showed average removals by anaerobic digestion of 54 per cent of total solids, 68 per cent of volatile solids, 83 per cent of organic nitrogen, and 78 to 94 per cent, averaging 84 per cent, of B.O.D., with the production of 7.5 cu. ft. of gas per pound of volatile matter added. The gas contained 25 per cent CO_2 and 1.5 per cent H_2S.

To determine whether laboratory results could be duplicated in large scale operation, and to collect data to serve as a basis for design of a full scale treatment plant, a pilot plant was constructed and operated at the Old Bridge, N. J., yeast plant of Anheuser-Busch, Inc.

Description of Plant

The pilot digesters (Figure 1), based upon the principle of continuous upflow digestion, consisted of two wood-stave digestion tanks, each of 16,000 gal. total capacity, and a steel hopper-bottomed circular settling tank for the retention of carried-over sludge. The digestion tanks were each fitted with a gas dome. On each tank was a manifold effluent line with four laterals, so that the liquid content of the tank could be maintained at 9,500, 11,000, 12,500, or 14,000 gal. as desired. Piping and valves were so arranged as to offer a maximum degree of flexibility. The capacity of the tanks could be varied, and a number of different flow plans could be used (in parallel, maintaining one-stage digestion, or in series, resulting in two-stage digestion). The digesters were heated by steam coils hung along the walls 6 ft. from the bottom, and the temperature was maintained at 85° F.

Raw material was fed continuously at the bottom, through a 1¼-in. nozzle equipped with a splash plate, passing through the sludge blanket in an upward direction to the effluent pipe, through which the digested material flowed by gravity to the settling tank. Flow rates were controlled by means of calibrated V-port valves. Sludge collected in the settling tank was periodically returned to the digesters.

B.O.D. Reduction

The yeast-spent nutrients and wash waters have a high B.O.D. and rather

* Paper of the Journal Series, New Jersey Agricultural Experiment Station, Department of Sanitation, Rutgers University.

FIGURE 1.—Digestion tanks, Anheuser-Busch pilot plant, Old Bridge, N. J.

low suspended solids content. In the treatment process B.O.D. reduction is of prime importance. Hence, studies were conducted to ascertain the effect of various factors on B.O.D. reduction by the digester, to determine the degree of purification attainable, to obtain data for design, and to establish proper operating procedures for a full scale plant.

Comparison Between One- and Two-stage Operation

A comparison was made of one- and two-stage operation by operating the digestion tanks in parallel and in series, respectively. The loadings, expressed in pounds B.O.D. per cubic foot digestion capacity, were varied. The average results obtained for low loadings in a range from 0.02 to 0.05 lb. B.O.D. are graphically shown in Figure 2 as daily B.O.D. reduction. The two-stage, or series, operation resulted in consistently higher removals at all loadings as compared with the one-stage, or parallel, operation of the digesters. The average percentage B.O.D. reduction for one-stage operation amounted to 56 per cent, whereas the average reduction for all loadings applied to the two-stage digesters was 80 per cent. Because of the material increase in efficiency with two-stage digestion all further digestion studies were performed with two-stage or series operation.

B.O.D. Loadings

B.O.D. loadings were controlled by varying the proportion of spent nutrients and wash waters in the daily doses, so that the volumes treated were kept constant. A second method of varying the loading was by controlling the rate of flow of raw material into the digesters.

A summary of the large number of data obtained during five years of experimentation is given in Table I.

TABLE I.—Effect of Digester Loading on B.O.D. Reduction; Summarized Pilot Plant Results

Daily B.O.D. Loading (lb./cu. ft.)	B.O.D. Reduction (lb./cu. ft.)	Efficiency B.O.D. Reduction (%)		
		Tank 1	Tank 2	Total
0.010	0.006	40	20	60
0.018	0.012	44	22	66
0.024	0.017	50	21	71
0.035	0.029	58	26	84
0.044	0.036	59	23	82
0.051	0.040	53	31	84
0.061	0.046	56	20	76
0.070	0.060	73	13	86
0.085	0.070	62	20	82
0.095	0.090	85	10	95
0.121	0.107	74	14	88
0.136	0.111	62	20	82

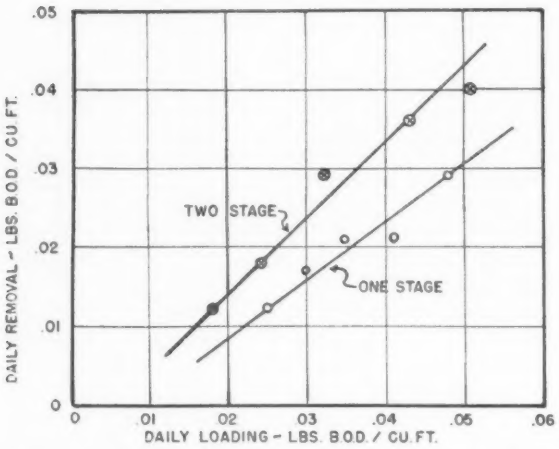

FIGURE 2.—Comparison of one- and two-stage digestion.

Maximum daily B.O.D. loadings of 0.136 lb. per cu. ft. total digester capacity were attained with a reduction of 62 per cent in the primary digester and 20 per cent in the secondary digester. Of particular interest is the fact that with loadings of from 0.01 to 0.035 lb. per cu. ft. the digesters effected from 60 to 70 per cent B.O.D. reduction, with an average of 66 per cent, whereas with loadings from 0.035 to 0.136 lb. per cu. ft. the B.O.D. reduction amounted to 76 to 95 per cent, or an average of 84 per cent. There was no indication that the maximum loadings had been achieved.

It is of interest to compare the results obtained in the large pilot plant with the laboratory results (3) on the basis of B.O.D. loadings and B.O.D.

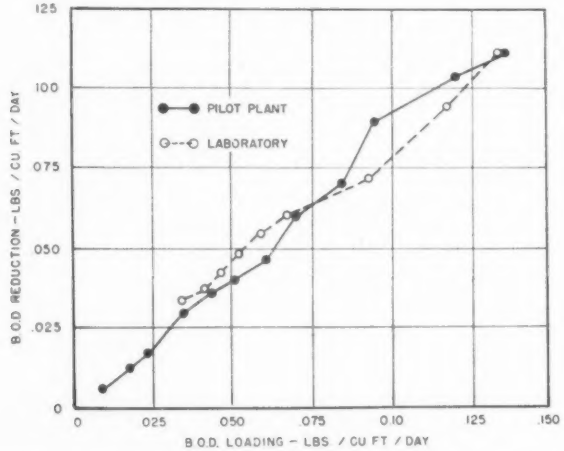

FIGURE 3.—Comparison of B.O.D. removal in pilot plant and laboratory experiments.

reductions (Figure 3). Under both laboratory and pilot plant conditions the pounds B.O.D. reduced increased with increased loadings.

Of the over-all B.O.D. removal an average of 78 per cent of the work was accomplished in the first stage of digestion and 22 per cent of the total work in the secondary stage. However, with very low loadings the B.O.D. reduction per unit loading was of the same order in the secondary digester as in the primary tank. This is illustrated in Figure 4. It appears, therefore, that the conception of a two-stage digestion system as one treating the easily digestible materials in the first stage and the more resistant materials in the second stage does not apply to this type of waste, within the loading range studied.

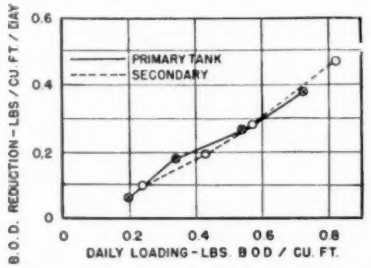

FIGURE 4.—Comparison of B.O.D. reduction in primary and secondary digestion.

Effect of B.O.D. Concentration

With an increase in concentration of raw material the food supply for the organisms responsible for digestion increased without the assumed benefit of removal of by-products through dilution and elutriation. A comparison of average results on the B.O.D. in the influent and effluent of the digesters (Table II) shows that with increasing strength of the raw material the B.O.D. of the effluent increases, but not in proportion to the strength of the raw material. As the strength of the raw material increases from 800 to 4,000 p.p.m. B.O.D. the effluent increases from about 300 to 600 p.p.m. With stronger waste the B.O.D. of the effluent increases sharply. The comparatively slow increase in B.O.D. of the effluent in the lower range of feeding reflects a steady increase in the efficiency of the digesters from approximately 65 per cent reduction to 85 per cent. When the loading increases beyond 3,900 p.p.m. B.O.D. the percentage B.O.D. reduction decreases, although the work done by the digesters is greater.

TABLE II.—Effect of B.O.D. Concentration on Effluent Quality and Digester Efficiency

Raw B.O.D. (p.p.m.)	Effluent B.O.D. (p.p.m.)	Reduction (%)
894	283	68
1192	415	65
1612	445	69
2050	450	78
2406	520	78
2810	586	79
3254	600	79
3400	640	81
3900	600	85
4800	1260	74
5000	1140	75

Effect of Volume Dosage

The effect of volume dosage on B.O.D. reduction by digestion was studied over a range of 3,760 to 10,000 gal. of material per day, representing theoretical detention periods of 3.7 to 1.4 days. Results showing the relation between loadings in lb. of B.O.D. per cu. ft. per day, and B.O.D. reduction, are graphically shown in Figure 5. The volume changes between 3,760 and 10,000 gal. per day did not appear to affect the reduction of B.O.D. per pound of B.O.D. added.

Effect of Neutralization

Laboratory experiments had shown that neutralization of mixtures of raw spent nutrients and wash water with

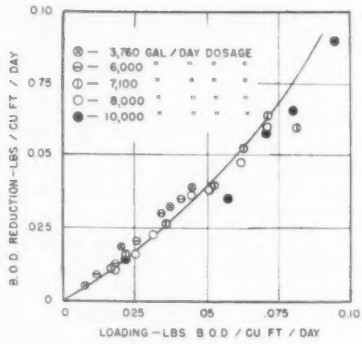

FIGURE 5.—Effect of volume dosage on B.O.D. reduction.

lime was not necessary to obtain maximum efficiency during digestion. During the operation of the pilot plant, digester influent was neutralized with sodium hydroxide and sodium carbonate to determine the affect on digestion and filter operation. A comparison of B.O.D. reduction during digestion of materials neutralized to pH 6.5 and 7.0 with B.O.D. reductions of non-neutralized digester influent at different loadings is given in summarized form in Table III. At loadings of 0.01 to 0.05 lb. B.O.D. per cu. ft. per day the averaged results do not indicate a material difference in efficiency between neutralized and non-neutralized materials. There are, however, other considerations which may make it desirable to neutralize the influent to the digesters. The desirability of neutralizing the waste will be discussed in a subsequent paper.

Solids Reduction

The total solids of the waste, varying between 1 and 2 per cent, consist almost entirely of dissolved materials. From 70 to 75 per cent of the dissolved material is organic in nature.

Dissolved solids loadings of 0.08 to 0.44 lb. per cu. ft. per day resulted in an average destruction of 51 per cent of the solids, as compared with an average of 54 per cent found in laboratory experiments. Within the range of 5,000 to 17,000 p.p.m. dissolved solids in the raw spent nutrients, the solids content of the digester effluent remained practically constant at a value of 5,400 p.p.m., but with raw material of a higher solids content, the solids increased in the effluent. The relation between solids loadings and removals is graphically illustrated in Figure 6. The results show an apparent increased efficiency with increases in concentration of the raw spent nutrient. The results further indicate that maximum loading had not been reached as evidenced by the fact that the rate of increase of removal, or work accomplished, showed no material decrease with the higher loadings. On the other hand, it appears that there exists a maximum spent nutrient concentration, beyond which the soluble solids

TABLE III.—Effect of Neutralization on B.O.D. Reduction

Control			Influent Neutralized to pH 6.5-7.0		
B.O.D. Loading (lb./cu. ft.)	B.O.D. Reduction		B.O.D. Loading (lb./cu. ft.)	B.O.D. Reduction	
	Lb./Cu. Ft.	Per Cent		Lb./Cu. Ft.	Per Cent
0.013	0.0095	73	0.008	0.0055	69
0.019	0.014	74	0.021	0.0145	69
0.031	0.023	74	0.029	0.020	69
0.043	0.034	79	0.040	0.033	83
0.052	0.040	77	0.050	0.040	80
0.060	0.046	77	—	—	—

content of the digested effluent increases sharply (Table IV).

The reduction of over 50 per cent of the solids accomplished within about 3 days or less is considerably higher than normally obtained in digestion of sewage sludge with approximately the same volatile matter content during a period of 30 days digestion.

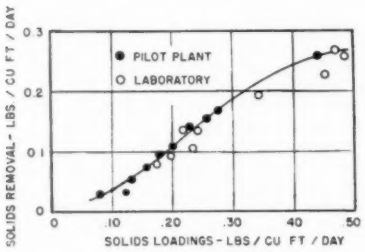

FIGURE 6.—Relation between loadings and removals of dissolved solids.

TABLE IV.—Effect of Dissolved Solids Concentration on Quality of Effluent and Digester Efficiency

Raw Spent Nutrient (p.p.m.)	Digester Effluent (p.p.m.)	Removal (%)
5,600	5,200	7
6,500	4,900	25
7,700	5,000	35
8,500	5,700	33
9,700	5,600	42
10,400	5,400	48
11,600	5,100	56
12,500	5,500	56
13,300	5,300	60
14,400	5,700	60
16,900	5,100	70
19,700	7,800	60

Destruction of Volatile Matter

Volatile matter reduction of sewage sludge (containing 75 per cent volatile matter) may vary between 50 to 55 per cent after 30 to 40 days digestion. Carefully controlled laboratory experiments have shown (4) that total volatile matter reduction of fresh sewage solids after 257 days digestion amounted to 57.4 per cent. When industrial waste high in volatile matter is present, the percentage reduction may be somewhat higher.

The pilot plant results on digestion of yeast waste show that with volatile matter loadings of 0.053 to 0.360 lb. per cu. ft. per day the average volatile matter destruction amounted to 64 per cent of the volatile matter added, with no indications that the maximum loading had been reached. With the higher loadings volatile matter destruction was well over 70 per cent Table V). The relation between volatile matter loadings and reduction is clearly shown in Figure 7. Destruction of volatile matter of the same order had been observed in laboratory experiments.

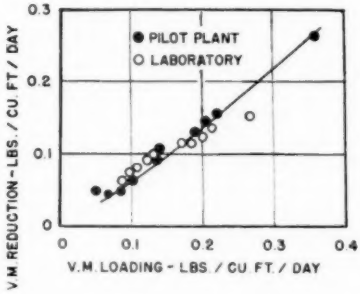

FIGURE 7.—Relation between volatile matter loadings and reduction.

With volatile matter concentrations of from 4,000 to 13,000 p.p.m. in the raw material, the volatile matter concentration of the digester effluent was 3,000 p.p.m. Above 13,000 p.p.m. of volatile matter in the raw material the volatile matter concentration in the digester effluent increased to about 4,000 p.p.m.

Gas Production and Composition

Gas production varied directly with the volatile matter loadings (Figure 8), amounting on the average to 7.5 cu. ft. per lb. volatile matter added.

TABLE V.—Volatile Matter Reduction

Pilot Plant			Laboratory		
Loading (lb./cu. ft./day)	Reduction (lb./cu. ft./day)	Removal (%)	Loading (lb./cu. ft./day)	Reduction (lb./cu. ft./day)	Reduction (%)
0.053	0.036	68	0.089	0.063	71
0.070	0.045	64	0.101	0.069	68
0.088	0.047	55	0.112	0.079	71
0.103	0.063	61	0.123	0.090	73
0.134	0.092	69	0.133	0.093	70
0.141	0.108	78	0.169	0.115	68
0.190	0.130	69	0.185	0.114	62
0.202	0.148	73	0.199	0.124	63
0.220	0.157	72	0.213	0.137	65
0.354	0.266	75	0.266	0.155	58

The results on total gas production, together with the amounts of carbon dioxide and hydrogen sulfide in the gas at different loadings are summarized in Table VI. Of interest is the fact that gas production per pound of volatile matter gradually increased with the loading up to about 0.07 lb. volatile matter per cu. ft. digestion capacity, but decreased with higher loadings. Significant in this respect is the fact that the percentage of CO_2 in the gas gradually increased from 18.2 at the lowest loadings to 32.7 at the highest loadings. Hydrogen sulfide present in the gas averaged 2.0 per cent at the lowest loadings to 3.9 at the highest. The percentage combustible gas gradually decreased with increased volatile matter loadings. The CO_2 and H_2S contents of the gas appear to be functions of the loadings. Since the digestion was performed in two stages, it can be expected that the gas produced from the first stage should have a lower heat value than the gas from the second stage, because the actual loading in the first stage is much higher than in the second stage. Average results obtained on the composition of the gas produced at different loadings from the first and second

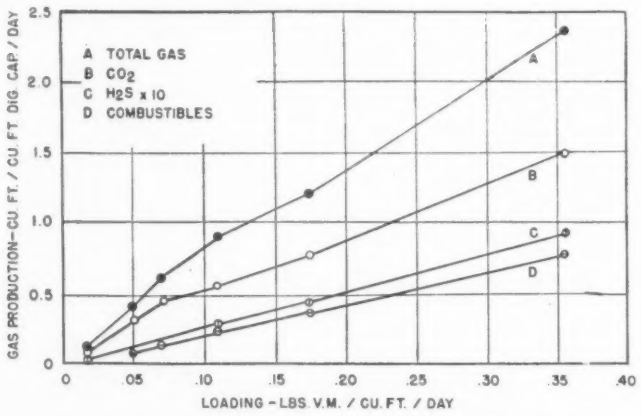

FIGURE 8.—Relation between gas production and loadings.

TABLE VI.—Gas Production in Relation to Loadings

Daily Loading Volatile Solids (lb./cu. ft.)	Cu. Ft. per Cu. Ft. Digester Capacity per Day				Cu. Ft. per Lb. Volatile Matter Added
	Total Gas	CO_2	H_2S	Combustibles (by difference)	
0.018	0.130	0.027	0.003	0.100	7.2
0.051	0.398	0.081	0.008	0.309	7.8
0.070	0.595	0.138	0.012	0.445	8.5
0.111	0.799	0.231	0.026	0.542	7.2
0.174	1.200	0.371	0.041	0.788	6.9
0.354	2.360	0.773	0.092	1.495	6.7

stages are shown in Table VII. In the first stage of digestion, the CO_2 content of the gas increased by 90 per cent with increased loading and the H_2S by 100 per cent, whereas the increases in the second stage amounted to 55 and 56 per cent respectively.

Nitrogen Changes

Digestion resulted in an increase in ammonia content, while the total Kjeldahl nitrogen remained constant; thus, by difference, indicating a decrease in organic nitrogen, as shown in the following average data:

	Raw	Digested	
		1st Stage	2nd Stage
Total Kjeldahl N (p.p.m.)	985	1025	995
Ammonia N (p.p.m.)	325	850	825
Organic N (by difference) (p.p.m.)	660	175	170
Organic of Total N (%)	67	17	17
Organic N Destroyed (%)	—	74	74

The conversion of organic nitrogen to ammonia occurred in the first stage, with no significant further activity in the second stage.

Loadings of 0.017 lb. organic nitrogen per cubic foot per day were attained within the mechanical limits of the pilot plant, without apparently having reached the maximum organic nitrogen loading. The results thus obtained coincided with laboratory results, as shown in Figure 9.

The organic nitrogen concentration of the digester effluent appears to be more dependent on the organic nitrogen concentration of the raw spent nutrient than is the case with B.O.D., total solids, or volatile matter, as indicated in Table VIII. With raw materials containing from 300 to 600 p.p.m. organic nitrogen the digester effluent contains from 70 to 150 p.p.m., whereas with raw material containing more than 600 p.p.m., the organic nitrogen concentration of the effluent in-

TABLE VII.—Composition of Digester Gas

Volatile Matter Loading (lb./cu. ft./day)	CO_2 (%)			H_2S (%)			Combustibles* (%)		
	Tank 1	Tank 2	Ave.	Tank 1	Tank 2	Ave.	Tank 1	Tank 2	Ave.
0.018	18.7	16.9	18.2	2.1	1.8	2.0	79.2	81.3	79.8
0.051	22.3	19.7	21.6	2.1	1.7	2.0	75.6	78.6	76.4
0.070	24.4	20.2	23.2	2.4	1.6	2.1	73.2	78.2	74.7
0.111	31.0	24.6	28.9	3.8	2.0	3.3	65.2	73.4	67.8
0.174	32.9	26.1	30.9	3.8	2.6	3.4	63.3	71.3	63.7
0.354	35.5	26.2	32.7	4.3	2.8	3.9	60.2	71.0	63.4

* By difference.

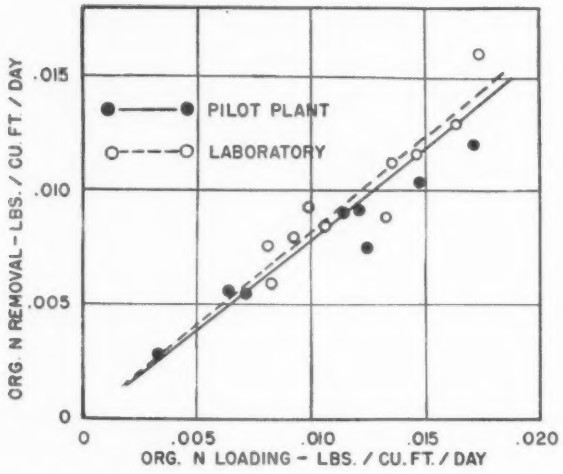

FIGURE 9.—Relation between organic nitrogen loadings and reduction.

creased sharply. The efficiency, as measured by the percentage removal of organic nitrogen, remained rather constant, showing only a slight decrease over the range of 300 to 750 p.p.m. organic nitrogen in the influent.

TABLE VIII.—Effect of Organic Nitrogen Concentration on Effluent Quality and Digester Efficiency

Raw Organic N (p.p.m.)	Organic N in Effluent (p.p.m.)	Organic N Removal (%)
308	71	77
432	122	74
532	136	74
614	145	77
678	173	75
729	200	73
771	230	70
799	312	61

Discussion

The data obtained during the pilot plant digestion experiments have purposely been compared with results obtained previously on a laboratory scale. It is of considerable interest that the results obtained from pilot plant operation, whether solids destruction, volatile matter destruction, B.O.D. reduction, gas production and composition, or destruction of organic nitrogen is considered, are of a similar magnitude to those obtained during laboratory experimentation. In other words, the digester efficiency at a given loading was the same in the pilot plant of 28,000 gal. capacity as in the small 4-liter laboratory vessels. These close relationships afford the opportunity for laboratory control of the digestion process, and allow rather accurate predictions from laboratory experimentation. The latter is of especial importance in connection with any contemplated changes in operation made necessary because of modifications in the production processes.

The data presented show that B.O.D. reduction, in terms of actual pounds removed per unit of digestion capacity per day, is a direct function of the B.O.D. loading, regardless of whether the raw spent nutrients are added as a stronger material during a longer detention period or as a weaker material for a shorter detention period. Regardless of the detention period (from 1.4 to 3.7 days) the number of pounds

of B.O.D. removed per day was directly proportional to the number of pounds added each day to the digesters, except in the very low range above 0.10 lb. per cu. ft. per day. In the low range not only was the percentage B.O.D. reduction low, but the performance in pounds removed was also relatively low. This may indicate that the available organisms received insufficient food to perform at maximum capacity, whereas at the high loadings the food supply was in excess of that which could be readily handled at optimum efficiency. It appears, therefore, that for optimum performance, loadings should not exceed 0.10 lb. B.O.D. per cu. ft. per day. This does not mean that with higher loadings the actual pounds of B.O.D. removed may not be higher than at lower loadings, but that the efficiency, as expressed in percentage removal, would be less at higher loadings.

Similar relationships were observed between loadings and reductions when dissolved solids and volatile matter destruction were considered. Furthermore, conversion of organic nitrogen to ammonia was, in general, directly proportional to the loadings. It is possible, therefore, to use the changes of any one of the constituents as an index of the changes in other components, or to gauge the performance of the entire digestion process by the changes in a single component.

Digestion of the soluble organic nutrient appears to proceed in proportion to the available food. With the same loadings the secondary digester performed as much work as the primary digester; however, when the food supply in the secondary digester was less than in the primary digester, the percentage reduction was less. The apparent reduction in efficiency of the secondary stage (Table I) is an illustration of the reduced food supply available for decomposition and gasification.

Since the efficiency of the digestion is related to the loadings, it is possible to obtain any desired percentage of reduction by varying the loadings. This is illustrated by plotting the percentage reductions obtained with various first-stage loadings (Figure 10). With a loading of 0.12 lb. B.O.D. per cu. ft. per day the reduction amounted to 99 per cent, whereas with 0.25 lb. per cu. ft. per day the reduction was about 60 per cent. The actual amount of work done at the higher loading is greater, indicating that at the low loading optimum conditions were not reached. Of practical importance is the fact that the efficiency or percentage B.O.D. reduction can be pre-arranged by controlling the applied loading. Thus, within limits, digester capacity and detention time can be determined on the basis of B.O.D. reduction requirements; that is, for any given B.O.D. reduction as required, data on maximum allowable loading and on capacity requirements can be readily obtained, if the volume and concentration remain relatively constant. Figure 10 shows B.O.D. reductions achieved at various loadings both in one- and two-stage digestion systems. If the strength and volume of a soluble organic waste to be treated by anaerobic digestion, are relatively constant, the data in this curve may be used to determine necessary design data.

For example, if 100,000 gal. per day of a waste of 5,000 p.p.m. B.O.D. are to be treated in this way, with 95 per cent B.O.D. reduction, a two-stage digester loaded at a rate of 0.095 lb. per cu. ft. per day would be required. This loading, with strength and volume constant, would require a total digester capacity of 44,000 cu. ft., or a 79-hour detention period.

If only 70 per cent B.O.D. reduction is required, it could be achieved with a one-stage digester loaded at a rate of 0.249 lb. per cu. ft. per day, necessitating a digester capacity of 16,800 cu. ft., or a 30-hour detention period.

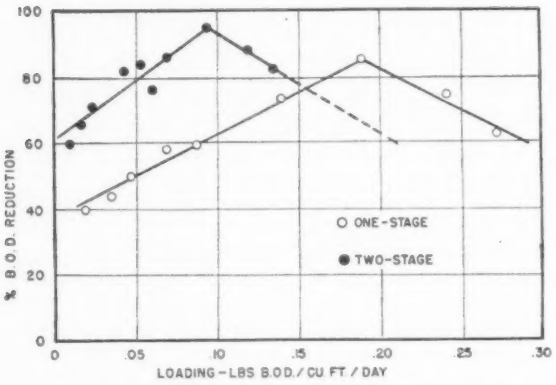

FIGURE 10.—Relation between effluent and loadings.

Further examples are shown in Table IX.

Within certain limits, it has been shown that with any of the indices used (total solids, volatile matter, B.O.D. or organic nitrogen) the quality of the effluent does not change materially with the concentration of the raw material. This can be expected if the optimum efficiency of the digesters is related to the loadings. However, if the material added to the tank has a very low concentration, factors affecting the turbulence or short circuiting in the tank play a role when the same loading, expressed in terms of any of the indices used, is applied as when the material is concentrated. The indices used do not seem to be equally sensitive. Whereas with B.O.D. values of 1,100 to 4,000 p.p.m. an effluent of 500 to 600 p.p.m. was produced, the range over which the organic nitrogen content of the effluent remained constant was not so broad.

TABLE IX.—Determination of Design Data for Various B.O.D. Reductions

Desired B.O.D. Reduction (%)	Maximum Allowable Loading (lb./cu. ft./day)	Design Requirements	
		Digester Capacity (cu. ft.)	Minimum Detention Time (hr.)
One-Stage			
85	0.190	22,000	40
80	0.209	20,000	36
75	0.228	18,300	32.5
70	0.249	16,800	30
65	0.269	15,500	27.5
60	0.288	14,500	26
Two-Stage			
95	0.095	44,000	79
90	0.112	37,300	67
85	0.127	33,900	60
80	0.144	29,000	53
75	0.160	26,000	48
70	0.176	23,700	42
65	0.192	21,800	38
60	0.208	20,000	36

Total gas production averaged 7.5 cu. ft. per lb. volatile matter added, or about 10 cu. ft. per lb. volatile matter destroyed. On this basis the quantities of gas produced in a full scale plant would be sufficient to serve as fuel in the manufacturing plant, thereby partly defraying the operation cost of the treatment process. The volume of total gas produced per pound of volatile matter in the yeast plant waste is comparatively low as compared with the gas produced from sewage sludge. This is probably due to the rather low fat and grease content of the yeast plant waste.

H_2S content of the gas is relatively high when compared to that found in average sewage gases; however, in view

of the fact that the spent nutrient contains 1,000 to 2,000 p.p.m. sulfate and that sulfate reductions of 75 per cent and higher were observed during digestion, the percentage H_2S in the gas was rather low. Of interest is that only about 60 per cent of the total reduced sulfate was accounted for in the H_2S of the gas, whereas about 10 per cent was found as sulfide in the effluent. A slight increase of sulfide was found in the sludge. The presence of free sulfur was observed in the digestion effluent and the sludge. Studies on a sulfur balance will be reported in a future paper.

Summary and Conclusions

Digestion experiments on yeast plant wastes were conducted over a period of 5 years in a 28,000-gal. capacity, two-stage pilot plant with the following generalized results:

1. Two-stage digester operation produced greater B.O.D. reduction per unit B.O.D. loading than did one-stage operation.

2. Loadings, in terms of pounds per cubic foot per day of 0.45 lb. total solids, 0.34 lb. volatile matter, 0.13 lb. B.O.D. and 0.017 lb. organic nitrogen were attained.

3. Average removals of 54 per cent of total solids, 68 per cent of volatile matter, 85 per cent of B.O.D. and 74 per cent of organic nitrogen were effected.

4. Total gas production amounted to 7.5 cu. ft. per lb. volatile matter added; the gas contained, on an average, 25 per cent CO_2 and 2.5 per cent H_2S.

5. Within limits, until a maximum point was reached in each case, the concentration of total solids, volatile matter, B.O.D. or organic nitrogen in the digester effluent was not a function of the concentration of the raw material.

6. A high degree of correlation was observed between laboratory data and pilot plant results.

7. Data were gathered for the design of a full scale treatment plant, and a method of operation was established for the treatment of this type of soluble organic industrial waste.

References

1. Jensen, K. E., "Purification of Waste Water from Yeast Factories." *Trans.*, Chem. Engr. Congr. of World Power Conf., **3**, 253 (1937).
2. Schlenz, H. E., "Controlled Digestion." THIS JOURNAL, **16**, 514 (1944).
3. Rudolfs, W., and Trubnick, E. H., "Compressed Yeast Wastes Treatment, II. Biological Treatment in Laboratory Pilot Units." THIS JOURNAL, **21**, 100 (1949).
4. Rudolfs, W., "Decomposition of Grease During Digestion, Its Effect on Gas Production and Fuel Value of Sludges." THIS JOURNAL, **16**, 1125 (1944).

INDUSTRIAL WASTE CONTROL POLICY OF WESTCHESTER COUNTY, N. Y.*

By Thomas M. Riddick

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Westchester County, situated just north of New York City, is largely residential and is industrial to only a minor extent. However, to control industries already established and to provide guidance for those which may be established in the future, the writer was retained by the County to formulate appropriate broad rules and regulations to cover the discharge of trade wastes into County sewers. The regulations, as submitted, are as follows:

COUNTY OF WESTCHESTER DEPARTMENT OF PUBLIC WORKS

Rules and Regulations Governing Discharge of Industrial Wastes Into Sewers Under the Jurisdiction of the Westchester County Department of Public Works

1. *General Purposes of Regulations*

These rules and regulations have been formulated for the general guidance of industries petitioning to discharge wastes into the County Sewerage System They are subject to revision or modification at any time. Their general purpose is:

(a) To prohibit excessive volumes and /or rates of flow of wastes into the County Sewerage System. (Maximum volumes and/or rates will be established for each petitioning industry, based on conditions as found.)

(b) To prohibit the introduction of trade wastes which create operating difficulties at plants now existing or those which may be constructed in the future.

(c) To protect the physical, chemical, and bacteriological quality of the receiving water-course or courses, in accordance with requirements of the State, County, Interstate Sanitation Commission, or with any other regulatory body.

(d) To prohibit the introduction of wastes which create an operating expense greater than would have been required for an equal volume of raw domestic sewage.

2. *Establishment of Standards*

The following standards have been adopted to control the quality and quantity of wastes discharged into the Westchester County Sewerage System.

(a) From the standpoint of conservation of water supply, as much diverted ground or surface water as possible shall be returned to the ground or stream.

(b) Diverted water returned to the ground or stream shall contain as little pollution as possible. (This will generally necessitate segregation of waste liquors into "polluted" and "non-polluted" classifications.)

(c) The volume of polluted wastes which cannot be returned to the stream, and which must be discharged into the sewer, shall be kept to a minimum.

(d) All industrial wastes discharged to sewer shall be metered. Flows averaging less than 25 g.p.m. (36,000 g.p.d.) may be measured with a crest meter or similar approved device for registering total flow only. Flows in excess of 25 g.p.m. (36,000 g.p.d.) will require Venturi tubes, Kennison nozzles, weirs, or other approved devices, both to measure and record the instantaneous and total rates of flow. The maximum rate of discharge shall not exceed 10 times the average (24-hour) rate. In no case shall the rate of flow be sufficient to flood manholes, appreciably sur-

* Presented at 1948 Spring Meeting of the New York State Sewage Works Assn.; Niagara Falls, N. Y.; June 4-5, 1948.

charge sewers, or cause a reversal of normal sewage flow.

(e) Wastes discharged to sewer shall contain no viable pathogenic bacteria other than those normal to domestic sewage. All effluents from hospitals shall be chlorinated so as to maintain a free chlorine residual (after 30 minutes contact) of at least 10 p.p.m.

(f) Wastes shall contain no solids in solution which will precipitate greater than 1,000 p.p.m. upon acidification (pH below 5.5), alkalization (pH above 8.5), oxidation or reduction. Viscosity shall not exceed 1.10 upon discharge or after acidification, alkalization, etc., as outlined above.

(g) Limiting chemical characteristics are as follows:

Five-day, 20°C. B.O.D.	400 p.p.m. max.
Chlorine Demand (30 min., room temperature)	25 p.p.m. max.
Suspended Solids	400 p.p.m. max.
Settleable Solids (Imhoff Cone Test, 1 hour)	10 ml./liter max.
Hydrogen Ion Concentration (pH)	4.5 to 9.5

Color shall not exceed an intensity of 500 p.p.m. Samples shall be diluted with distilled water to bring the range within 10 to 50 p.p.m. and judged on a basis of "intensity" or transmission of light rather than "true color" (Platinum Cobalt Standard).

Grit, sand, abrasives, metal fillings, turnings, and other material of similar nature will not be tolerated.

3. *Undesirable Chemical Constituents*

The following chemicals or chemical compounds are undesirable.

They shall be eliminated from the industrial wastes or reduced by treatment to a concentration which will not adversely affect sludge digestion or any other biochemical or biological process normal to sewage treatment plants.

Arsenic and Arsenicals; Copper and Copper Salts; Mercury and Mercurials; Silver and Silver Compounds; Zinc; Toxic Dyes (organic or mineral); Sulfanamides; Phenols and their derivatives; Cresols; Alcohols; Formaldehydes; Chlorine in excess of 100 p.p.m.; Iodine; Fluorine; Bromine; all strong oxidizing agents such as Peroxides, Chromates, Dichromates, Permanganates, etc.; Oils and Greases; Compounds producing Hydrogen Sulphide or any other toxic, inflammable or explosive gases, either upon acidification, alkalization, reduction or oxidation; strong reducing agents such as Nitrites, Sulphites, Sulphides, etc.; inflammable or explosive liquids or solids.

4. *Holding Tank*

All wastes for discharge to sewer shall be collected in a single basin which shall provide a detention of not less than one-half hour at the maximum rate of flow, and two hours at the average rate.

These specifications were not prepared with the idea of imposing undue hardship on industry or necessitating a great number of small industrial treatment plants. The question of pretreatment of waste is a moot one, and there are many valid arguments both pro and con. However, the writer is definitely inclined to the view that industrial plants with "objectionable wastes" should collect all spent liquids in a central holding tank for metering, diluting, equalizing, and minimizing shock loads. If the chlorine demand is in excess of about 25 p.p.m. and the volume of waste is appreciable, it should be partially stabilized by the application of chlorine. This procedure seems necessary since a great many wastes are high in reducing compounds and these often result in a depletion of dissolved oxygen of the sewage in laterals as well as trunk lines. Past experience has surely shown the difficulty of effectively treating sewage which arrives at the plant in a septic condition.

The cost of this type of holding and oxidizing basin is quite reasonable, both in construction and operating charges. Precipitation does not always occur with this type of process and should be prevented if possible so that clarifiers, sludge handling, etc. will not be required at the industrial plant. The net result is primarily the elimination of excessive chlorine costs to the municipality and a reasonable assurance

that sewage will reach the treatment plant in a non-septic condition.

Attention is called to the fact that these standards apply to trade wastes discharged into trunk and lateral sewers whose primary function is the conveyance of domestic sewage. They are not applicable to industries discharging direct into streams, or into a trunk sewer whose principle function is the collection of trade wastes.

The writer respectfully submits these regulations, not as the last word by any means, but as a modest contribution towards objective thinking and planning.

NATIONAL PLUMBING CODE PLANNED

Hope that a uniform national plumbing code may at last be forthcoming is seen in a statement by Francis B. Elder, APHA Engineering Associate, before the New York State Sewage Works Association on January 21, 1949. In a move toward this end the U. S. Department of Commerce is now planning to form a joint committee consisting of representatives of various national plumbing, housing and public health organizations.

Mr. Elder noted that there are presently in existence more than 1800 local plumbing codes, a situation which engenders considerable confusion, waste and inefficiency. Reference was also made to four national or regional codes, namely, that used widely on the West Coast as adopted by the Western Plumbing Officials Association, the tentative code prepared by the Building Officials Conference of America, the "Uniform Plumbing Code for Housing" (Housing and Home Finance Agency), and the "American Standard Plumbing Code" (Committee A40, American Standards Association). Mr. Elder reported a favorable trend in that the latter two "national" codes differ in only a few minor elements.

The proposed joint committee will undertake to foster necessary research and to assemble basic data not now available. These functions are stated by Mr. Elder to be essential to the establishment of a nationally acceptable code. Mr. Vincent Manas, Office of Domestic Commerce, U. S. Department of Commerce, is taking a leading part in the creation of the new coordinating committee.

Stream Pollution

FACTORS INFLUENCING SELF-PURIFICATION AND THEIR RELATION TO POLLUTION ABATEMENT

II. Sludge Deposits and Drought Probabilities * †

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The purpose of sewage and waste treatment is to protect the condition of streams consistent with reasonable uses of the water heritage. In sewage and waste disposal it is not economically feasible to provide such a high degree of treatment as to return streams to virgin conditions. On the other hand, neither can our water resources be allowed to degenerate to a point where they are useful only as sewers. Approached from either of these extremes, the problem of stream pollution is too frequently over-simplified, as both ignore completely natural self-purification capacities. If pollution control and stream improvement are to be promoted on a sound and economical basis, with the support of taxpayers, it is essential to take into consideration natural self-purification. Recognition of this takes the problem out of the realm of legislative, legalistic procedures and makes it strictly an engineering endeavor.

An engineering approach implies a thorough understanding of all the factors at play. The rational allocation of stream uses, the establishment of realistic stream standards and the sound and economical design of sewage and waste treatment works—all rest fundamentally on the evaluation of the natural self-purification capacities peculiar to each particular stream.

Dynamic Character of Rivers

Rivers are individualistic, and natural purification capacities vary radically from stream to stream and from reach to reach along a river course. A river is not static; it is living, dynamic, constantly responsive to the laws of biological change and the vagaries that apply to living things. Further, each river is sensitively responsive to hydrologic fluctuations which follow the laws of chance and probability.

Natural self-purification is not a fixed quantity, but rather a range in variability of capacity associated with biologic and hydrologic change. Failure to recognize this dynamic character of natural purification results in rigid stream standards which cannot possibly be maintained under the normal patterns of stream variability.

Streams cannot be generalized; hence, stream standards cannot be applied wholesale to all rivers without regard to their widely varying natural self-purification capacities. Furthermore, standards cannot be rigidly applied to a particular river, as though self-purification were a fixed quantity, unrelated to hydrologic fluctuations or unrelated to varying purification capacity along the course of a stream. And worse than rigid stream standards

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† Part I published in This Journal, **19**, 4, 629 (July, 1947).

is the practice of arbitrarily specifying quality requirements of the effluents of sewage and waste treatment works, regardless of the varying natural purification capacities of different bodies of receiving water. There is no generalization and no short-cut to this problem. The essence of stream control and sewage and waste treatment design is the evalution of factors influencing self-purification in each specific case.

Self-Purification

Measures of stream condition, to be of value, must be expressed in terms quantitatively related to water quality, reproducible under similar conditions and related to a measure of efficiency of sewage and waste treatment. The best such single measure is the quantity of oxygen required to stabilize pollution by natural biological processes of decay, or biochemical oxygen demand. Where pollution is discharged into a stream, the oxygen requirements to satisfy this demand are obtained from the oxygen dissolved in the river water. If the demand for oxygen is excessive in relation to that available, the D.O. is exhausted and the stream goes into complete bankruptcy. Thus, the B.O.D. of pollution may be regarded as liabilities—outstanding debts—and the D.O. of the river water as assets. Stream solvency depends on the relation between rate of amortization of liabilities to the rate of income from assets, where oxygen instead of dollars is the medium of exchange.

On this basis, factors influencing the liability side can be listed as: the characteristics and quantity of pollution and its fluctuations; the rate of its amortization at various temperatures; any distortions such as immediate demand or lag; the effect on amortization of changes in time of passage down the river induced by variations in channel cross-sections and fluctuation in runoff, including artificial effects from dams and storage reservoirs augmenting low flow or diverting natural runoff. In addition, two factors which can radically alter the liability side of the ledger are extraction and storage of B.O.D. by biological growths on stream beds, and sludge deposits.

On the asset side, the two primary factors influencing cash-on-hand and the rate of income are the D.O. carried in the runoff and increments from tributaries, and reaeration. The first depends upon climatological and hydrologic characteristics of the drainage area and fluctuates with changes in runoff and temperature. Reaeration is a highly sensitive complex phenomenon, depending upon degree of oxygen depletion, temperature, river channel depth, volume and turnover, which factors in turn fluctuate with hydrologic changes. In addition, algae and nitrates may, under some environmental conditions, add to temporary income. Also, the effect of income may be produced by the loss of end products to the atmosphere, such as escape of H_2S.

Stream solvency or condition is the balance between income and outgo along the course of the stream, describing a resultant D.O. profile. Obviously, there may be an infinite number of profiles, depending upon the combination of factors at play at the moment. One of the important facts deserving emphasis is the varying nature of the resultant D.O. Each river sets up its particular amplitudes or ranges in D.O. profile variation.

Sludge Deposits

Scour

To illustrate the dangers of generalization and the necessity for detailed evaluation of self-purification, consider two factors: sludge deposits and drought probabilities. Suspended solids subject to deposit along the course of a stream or in pools behind dams can produce a wide variety of effects upon deoxygenation and, hence, upon resultant D.O. In a natural stream

the limiting factor which determines the occurrence and accumulation of sludge deposits is the velocity of flow at which scour commences. Shields has defined this critical velocity as

$$V_c = \sqrt{\frac{8Bg(s - 1)d}{f}}$$

where V_c is the mean channel velocity at which scour commences; B is a constant; g is the gravity constant; f is the Weisbach-Darcy friction factor; s is the specific gravity of the particle; and d its diameter.

From what is known of the performance of grit chambers, B for fresh depositions of organic matter is 0.06, and a critical velocity of about 0.6 f.p.s. is required to scour organic matter granular in shape with diameters up to one millimeter. Under natural stream conditions, greater turbulence due to a higher value of f would allow an increase in B up to 0.22 with comparable results. However, in the event channel velocities fall below 0.6 f.p.s. over extended periods, organic settleable solids will deposit and, in the process of accumulating, will cohere and compact, resulting in an increase in B. If B is assumed in such instances to increase to 0.8, the velocity required to induce scour of the accumulation would increase to 1.15 f.p.s., or practically double that where accumulation and compaction did not occur. Also, during accumulation deposited particles no longer remain discrete, since they coalesce to form larger aggregations; hence, the sizes to be scoured increase and the velocity required to induce scour will be further increased. To offset these tendencies, however, gases produced during digestion of organic deposits will agitate the accumulation and lift some particles into the flowing stream. Thus, fresh organic sludge deposits undergoing digestion may readily be scoured, probably at velocities between 0.6 and 1.0 f.p.s.

For resettled partially or wholly digested material for which active gasification has subsided, the previous tendencies adverse to scour hold, and higher velocities are required such as occur during freshets or flood discharges. Taking an extreme situation where B is 1.0 and organic deposits are stabilized material, a velocity to scour a 1 mm. diameter particle would be approximately 1.3 f.p.s.

A unique opportunity to observe such critical balances between channel velocity and deposit and scour was afforded in studies of the Kalamazoo River made for the National Council for Stream Improvement. Two deposit areas separated by an intervening clean stretch were observed. A study of river hydrology and channel cross-sections revealed the following relations. For the reach in the river in which no deposits occurred, it will be noted from Figure 1 that a channel velocity of 0.6 f.p.s. would not occur until the runoff declined to about 130 c.f.s. From probability studies it was determined that a runoff as low as this could be expected once in 20 years; hence, for practical purposes sludge deposit and accumulation, according to theory, were rarely permitted. The cross-section soundings through this reach revealed a complete absence of organic matter and a clean sand and gravel bottom.

The upper deposit area below the city of Kalamazoo is indicated by Curve B. Here, it will be noted, a channel velocity of 0.6 f.p.s. or less is attained at a runoff below 700 c.f.s., which occurs frequently each year; consequently, it can be expected that at times sludge of organic character will accumulate. It will be further noted, however, that with runoffs between 700 and 1,500 c.f.s., which also occur frequently each year, velocities would range between 0.6 and 1.0 f.p.s., sufficient to scour fresh actively decomposing sludge. An examination of cross-sections taken during a period

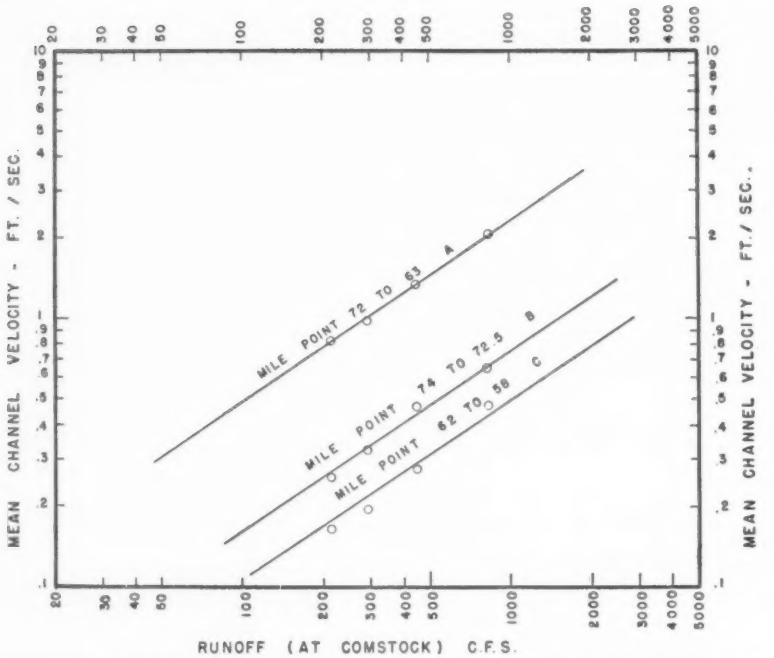

MEAN CHANNEL VELOCITY - FT. / SEC.
MEAN CHANNEL VELOCITY - FT./ SEC.
RUNOFF (AT COMSTOCK) C.F.S.
MILE POINT 72 TO 63 A
MILE POINT 74 TO 72.5 B
MILE POINT 62 TO 58 C

FIGURE 1.—Relation between mean channel velocity and runoff in the Kalamazoo River.

when the runoff was around 835 c.f.s. indicated the presence of organic sludge but no large accumulations.

Farther downstream in a pool area a large accumulation of relatively stabilized material was observed. For this area (Curve C) it will be noted that channel velocities of 0.6 f.p.s. or less occur when the discharge is below 1,500 c.f.s. Flows below this level occur for protracted periods, giving opportunity for extended accumulation. Thus, this zone receives the deposit bypassing or scoured from the upper area. Scour velocities in the pool area occur only during freshets and the flood season.

Such a critical balance of sludge deposits and scour with river runoff gives rise to a very sensitive dissolved oxygen profile with periods of very sharp, deep drops when runoff is such as to permit deposit and accumulation.

Accumulation and Demand

To experience oxygen depletion in the overlying water in excess of that which is normally expected by demands satisfied in the flowing stream, sludge deposits not only must be able to occur, but they must be able to accumulate. The extent of the demand exercised is primarily a function of the level of accumulation. The level of this storage, in turn, is a function of the rate of biological decomposition and the length of period during which deposit may take place without scour. In practical application, the latter is controlling and the exact rate of decomposition is of less importance. Unless interrupted by scour, sludge accumulation continues until the daily demand exerted by the accumulation equals the B.O.D. of the daily deposit added. A means for practical evaluation is af-

forded by Streeter's unimolecular equation:

$$L_d = \frac{P_d}{2.3k'}(1 - 10^{-k't'})$$

where L_d is the cumulative B.O.D. in pounds; P_d is the B.O.D. added to the deposit in pounds per day; k' is the specific rate of decomposition of the deposit; and t' is the time of accumulation in days.

To illustrate the varying character of demand with sludge accumulation, the following graphical simplification may assist:

Case I: This is the simple case of continuous, uninterrupted daily additions and a constant rate of biological decomposition (Figure 2). Assume that the daily deposit of B.O.D. of the suspended matter is 1 lb. and the logarithmic rate of decomposition constant k is 0.03 at 25° C. It will be noted that gradually the B.O.D. stored in the deposit accumulates and ultimately approaches an equilibrium level. When the equilibrium level is reached the daily demand from the accumulated deposit just equals the B.O.D. of the 1-lb. daily deposit added, A to B. It will also be noted that it takes two months or more of continuous uninterrupted depositing to approach this level.

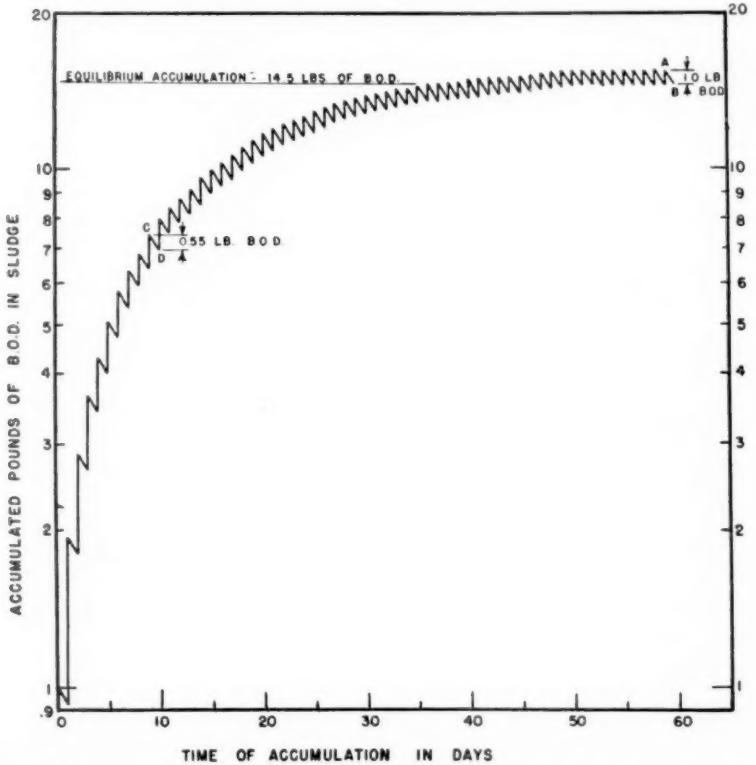


FIGURE 2.—Sludge accumulation and demand—Cases I and II ($k = 0.03$ at 25 C.).

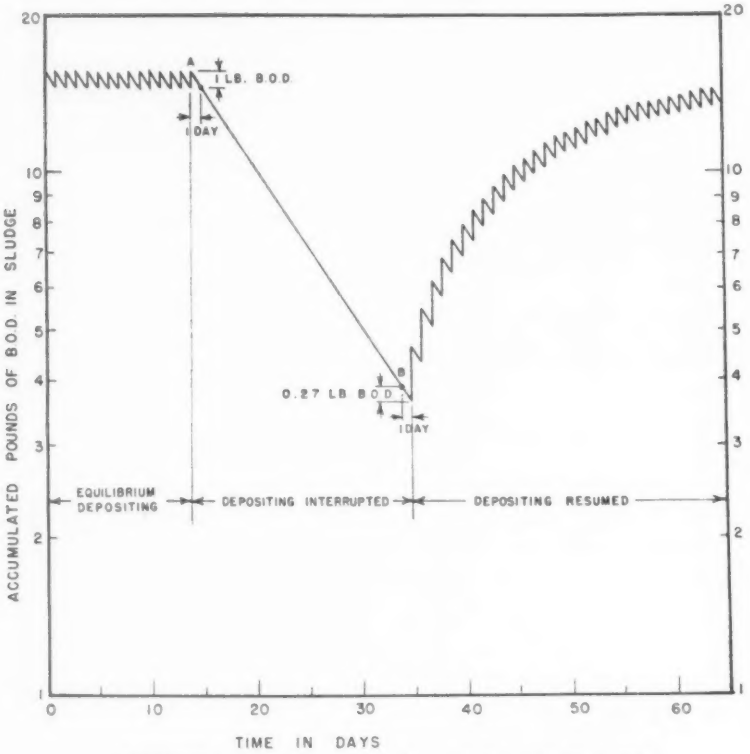


FIGURE 3.—Sludge accumulation and demand—Case III.

Case II: In many instances river hydrology will not permit two months of uninterrupted depositing, and in such cases the demand will be less than the B.O.D. of the daily deposit. An integration of the daily deposits for the stipulated period will provide the demand. For example, after 10 days the storage is 7.0 lb. of B.O.D. and the demand on the tenth day is only 0.55 lb.

Case III: This might be taken as the common instance of irregular interrupted depositing such as might occur when runoff is at times sufficiently high to by-pass the area or when sources of pollution are intermittently cut out (Figure 3). At A, deposits are interrupted and then biological decomposition continues on the past accumulation down to B, where again depositing is resumed. It will be noted that the demand at A is 1 lb. per day at equilibrium level, but at B, 20 days later, the demand has declined to 0.27 lb.

Case IV: A fourth case might be considered where complete scour associated with flood occurs, followed by a period of runoff sufficiently high to keep velocity above 0.6 f.p.s. During such a period there will be no sludge accumulation, and therefore no unusual demand on the overlying water (Figure 4).

Case V: A fifth case may occur where, following winter, a sudden rise in temperature, acting upon a large

accumulation of dormant sludge, induces active decomposition (Figure 5). Storage accumulates to 34.5 lb. and the high temperature demand on the excess accumulation is greater than the B.O.D. of the daily deposit, or 2.6 lb. This prevails only for a short period, as the excess accumulation declines to the equilibrium level of the new temperature. Usually such a situation does not occur as, fortunately, spring floods scour winter accumulations before warm weather sets in.

Case VI: A sixth case may occur as the reverse of this, in which with a sudden decline in temperature, the rate of decomposition falls off and the demand is less than the B.O.D. of the daily deposit (Figure 6). Assuming the accumulation is at equilibrium at 25° C., the demand, with the sudden drop in temperature, declines to 0.7 lb. Accumulation, however, now increases and as the new equilibrium level at the lower temperature is approached, the daily demand again approaches that of the B.O.D. of the daily deposit.

It is apparent from these simplified illustrations that, depending upon hydrologic conditions, the daily demand from sludge deposits may vary from a small fraction to more than the B.O.D. of the daily deposit added.

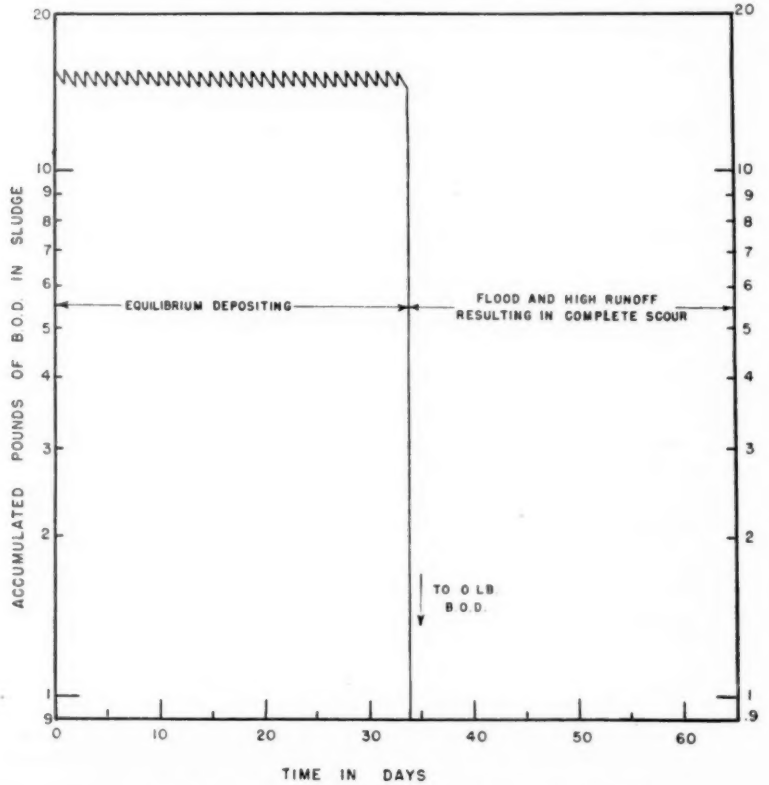


FIGURE 4.—Sludge accumulation and demand—Case IV.

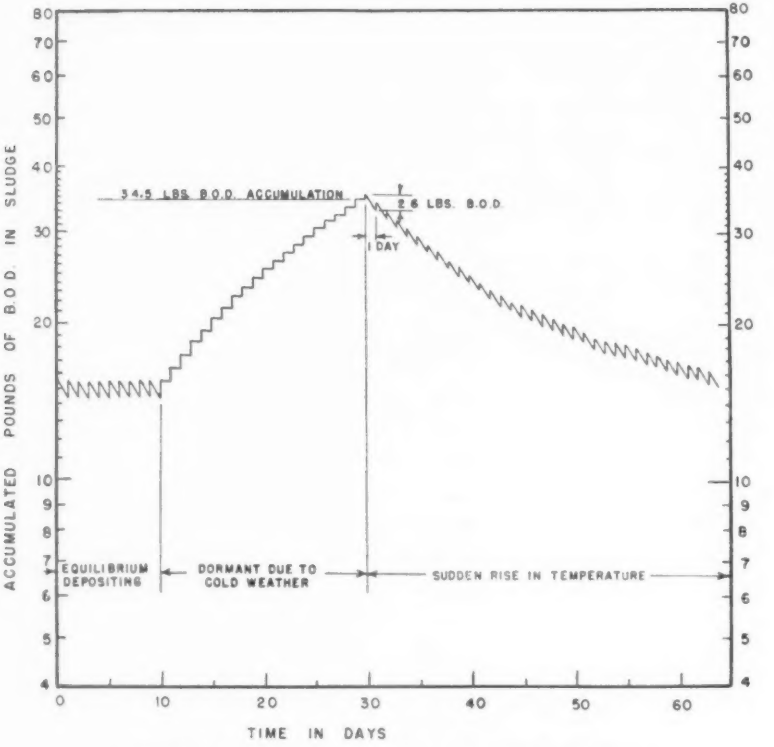


FIGURE 5.—Sludge accumulation and demand—Case V.

The extent of the distortion to the D.O. profile from sludge deposits, in addition to these examples of varying demand, depends upon the time of passage of the flowing water through the zone of deposit. If the time of passage is long—10 days or more—the difference in deoxygenation is slight because a large proportion of the B.O.D. would be satisfied in the flowing stream regardless of the occurrence or non-occurrence of deposits. On the other hand, where time of passage is short (a day or less) the deoxygenating effect of sludge deposits greatly exceeds that which takes place in the flowing stream in the short period, and a sharp drop in the D.O. profile occurs. However, in such instances the zone of deposit serves as a natural treatment device, reducing the debt load for downstream reaches and thus raising the downstream D.O. profile above normal.

No generalized expression such as the oxygen sag equation is applicable for refined analysis. Obviously, the effects of deposit cannot be lumped as an increased deoxygenation constant k. Not only is it necessary to compute deoxygenation and reaeration separately, but it is also essential to deal with separate fractions of the load, integrating the colloidal and dissolved B.O.D. fraction remaining in the flowing water; then separately integrating the suspended solids B.O.D. fraction, dropping out the residuals in the areas where veloc-

ity permits deposit. The deposited fraction, in turn, must be integrated at its decomposition rate over a considerable period prior to the date under investigation to obtain the quantity of accumulated storage.

Applying this technique of analysis to the reach on the Kalamazoo River previously referred to, Figure 7 shows a comparison of what normally would be expected at a given runoff with that actually produced as a result of sludge deposits. Curve A is the computed profile with pollution remaining in the flowing water, without sludge deposits. Curve B is the computed and observed profile as a result of sludge accumulation nearly at equilibrium. The sharp drop in vicinity of Mile Point 73 is caused by the upper sludge deposit zone; the rise in D.O. is associated with the intervening zone where no sludge deposits occur, followed by the sharp decline in pool areas where there is again accumulation. The improvement to the downstream profile resulting from upstream depositing is also noted. There may be any number of variations in D.O. profile between Curves A and B, depending upon sludge accumulation levels, determined principally by the prior pattern of runoff.

Drought Probability

Runoff plays a still larger role, for it affects assets as well as liabilities. Drought flows coincident with high

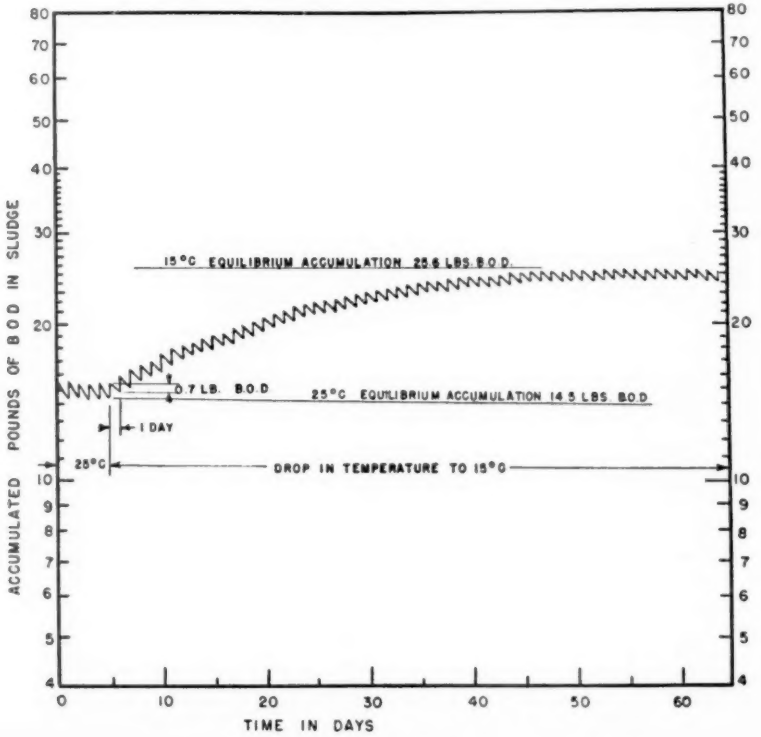

ACCUMULATED POUNDS OF B O D IN SLUDGE
TIME IN DAYS
15°C EQUILIBRIUM ACCUMULATION 25.6 LBS. B.O.D.
0.7 LB. B.O.D
25°C EQUILIBRIUM ACCUMULATION 14.5 LBS. B.O.D.
1 DAY
25°C
DROP IN TEMPERATURE TO 15°C

FIGURE 6.—Sludge accumulation and demand—Case VI.

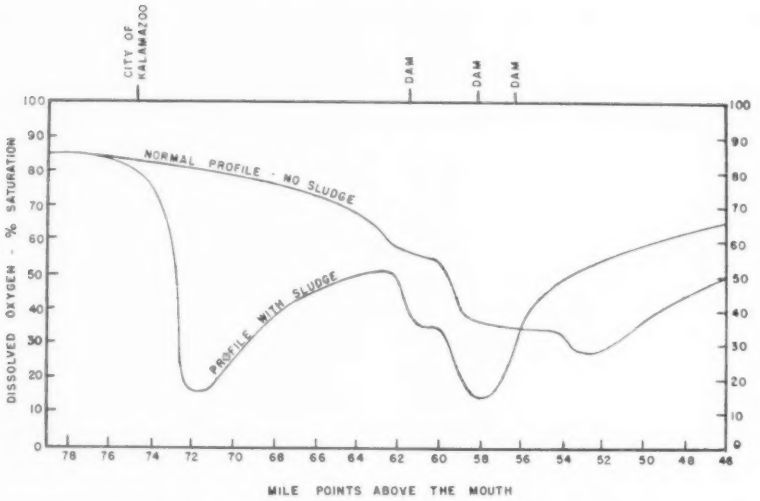


FIGURE 7.—Comparison of normal D.O. profile with distorted profile due to sludge deposits—Kalamazoo River.

temperatures produce the greatest strain on self-purification, as amortization demands are increased while income declines. Since droughts follow the laws of probability, no evaluation of self-purification is complete which does not include a statistical analysis of droughts for each stream. An excellent means of determining drought probabilities is afforded by the application of the theory of extreme values developed by Gumbel (1) (2) for flood flows. The full explanation of the use of the method would require a separate paper. The following example is offered, however, to illustrate the results of an application, to emphasize how radically the D.O. profile varies with different levels of drought severity, and how essential it is to recognize and consider drought probability in determining upon a stream improvement program.

Figure 8 is a set of computed D.O. profiles that would result from a certain treatment scheme at summer droughts ranging from 450 to 175 c.f.s. Probability studies disclosed that monthly average droughts of severity of 420, 292 and 219 c.f.s. may be expected once in 2, 5, and 10 years, respectively. It is noted that each drought flow produces its corresponding D.O. profile and obviously, as drought severity increases, the D.O. profile will decline; but, these declines are expected less frequently as drought severity increases. Further, it must be recognized that under the laws of probability there will inevitably occur, on rare occasions, a drought of such severity as to cause stream conditions to fall below a desired level. These are the tolerances which must be taken into consideration in any rational approach to stream control.

Stream pollution control is analogous to flood control in that costs of protection are balanced against runoff probability. Any level of protection can be designed for but, like any insurance, the premium is based on the risk. Obviously, it is not economically feasible to provide treatment which insures the desired stream conditions during drought flows of such rarity of occur-

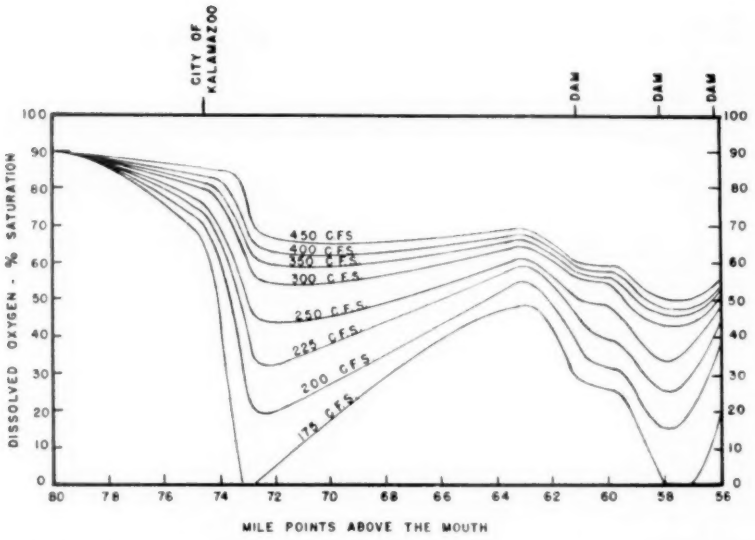


FIGURE 8.—Computed D.O. profiles Kalamazoo River; treatment scheme "C" (runoffs 175 to 450 c.f.s.).

rence as once in 100 years. On the other hand, it would be an economic waste to provide such limited treatment that a stream would degenerate below desired utility levels every year. Between these extremes lies the practical solution.

Practical Application

It is not enough academically to point out the factors influencing self-purification and their complexities. The gap between what is known and what is applied is too great. What is called for is the application of this knowledge to the practical problems of stream control and improvement. The essence of good stream standards is not high-sounding, impractical generalities on paper. The test is whether the standards in practice actually apply to the specific stream.

Similarly, good design for sewage and waste treatment is not measured by the beauty and mechanical perfection of the works. The test is the degree to which the system is capable of producing the required stream conditions. There is no easy, wholesale short-cut to pollution abatement and control. Each stream is a highly specialized problem, the rational and economical solution for which can be found only in a thorough engineering evaluation and application of the factors influencing self-purification.

References

1. Gumbel, E. J., "The Return Period of Flood Flows." *Annals of Mathematical Satistics*, **12**, 163 (1941).

2. Gumbel, E. J., "Flood Flows by the Probability Method." *Engineering News Record*, **134**, 97 (1945).

THE OPERATOR'S CORNER

WATCH THOSE WET-WEATHER FLOWS!

One of the articles included in The Corner this issue describes the elimination of storm water from the Wadsworth, Ohio sanitary sewer system. It illustrates a point often overlooked, namely, that the misuse of sanitary sewers by the connection of storm water drains generally is a gradual development which may go unrecognized until basements begin to flood or the sewage treatment works is overloaded with increasing frequency. The key position of the sewage works operator in this situation should be fairly obvious, but his role in controlling this type of sewer misuse very often is not recognized even by sewage works personnel.

By virtue of personal observations and the availability of plant flow records, the operator is the individual best able to recognize the significance of changes in sewage flow and to evaluate them in relation to the current community conditions. Illicit or improper storm water connections frequently can be made to the sanitary sewers without detection, in spite of municipal regulations and inspection services, but the effects of such connections cannot be concealed from an intelligent plant operator.

An operator must do more than record data, however, if he is to detect changing conditions. Only a critical and objective study of data will provide the perspective necessary for recognizing the long-time trends in sewer usage which gradual flow changes may reveal. This is one of the many benefits derived from the preparation of annual operation reports, when data are studied and compared with that observed over a long period of years. Flow variations which of themselves appear to have little significance, over a period of time may reveal an important pattern of change. The objective study of reliable sewage flow data is fundamental to the proper control of sanitary sewer connections.

An operator's interest in the problem does not end once the fact of sewer misuse has been established. The personnel at Wadsworth, Ohio determined the specific causes for the excessive storm water in the sanitary sewers and did something about them. The practical methods used for detecting storm water connections and the effective control measures applied at Wadsworth merit the consideration of all who are faced with a similar problem.

After sewer usage controls are adopted, a continuous check on their effectiveness is desirable. This is a service which the operator can contribute by closely watching flow fluctuations and correlating them with rainfall, industrial activity, water consumption and other local factors.

Storm water elimination from sanitary sewers is more than a constant and universal problem. To the alert sewage works operator it presents an opportunity for enlarging his service to the community and for demonstrating his initiative and resourcefulness.

S. C. MARTIN

PREVENTIVE MAINTENANCE AT SEWAGE TREATMENT PLANTS *

By Robert Howell

Water and Sewage Plant Foreman, Ravenna Arsenal, Apco, Ohio

There is an old saying that there is a first time for everything. That was hard for me to believe until I was asked to tell the story of what happened to me and thousands of others like me. I was very much surprised that anyone would be interested in my life or give me credit for being able to tell my life story for I am not very interesting to look at and have been ignored by many due to my physical condition. If I had been permitted to speak at various times when I was young and active, I could have saved my employer many anxious moments and a great deal of money. However, I am grateful for the opportunity to tell my story and I sincerely hope it will be of value to you.

I am an outcast, discarded and set aside because I am no longer of use to anyone. I am any piece of worn-out equipment at any sewage plant regardless of type, size, or place. In the beginning I was correctly designed and properly constructed to perform a given duty at a sewage treatment plant. I was properly installed and tested to the satisfaction of all concerned, and those who designed and built me sent along a set of operating instructions and a spare parts list to enable my employer to keep me in good condition. I had high hopes of a long and successful career, and it seemed impossible that I could ever fail to perform my duties in a fully satisfactory manner.

The operators were glad to have me and took pride in showing visitors how I performed. I was inspected periodically, greased occasionally, and had the dust wiped off the most conveniently exposed parts about once each week. As time went by it was taken for granted that I was not a trouble maker and could always be counted on to do my part at any time. My operating instructions and spare parts list were safely stored away in the bottom drawer of a desk, and other interests began to take up the time of the plant personnel. As I grew older, I complained a little from time to time, not too loudly at first, but loud enough to have commanded some attention if anyone had been near at the time. It seemed that the operator on duty was never quite finished with the sports page of the local newspaper, or it might have been the time that the superintendent's wife had to have the car cleaned in a hurry so, that she could take the wife of the chairman of the sewer committee out to dinner. At any rate, no one listened to me.

There were one or two exceptions however, when I did receive a little extra attention. Several high officials were holding an inspection of the plant and I was hastily cleaned and greased, and I did feel some temporary relief from a few of my minor ailments. The inspectors, however, missed the most important part of their mission and called the inspection very satisfactory. The operators and the supervision were then content to rest on their laurels, and I was soon in worse condition than before.

Finally I could stand it no longer and I had a breakdown. I was dismantled and my broken parts removed. Contrary to my expectations, I was not repaired at once. No, the blame for my condition had to be placed on someone. After the usual amount of

* Presented at 22nd Annual Meeting of Ohio Sewage and Industrial Wastes Treatment Conference, Dayton, Ohio, June 23–25, 1948.

passing the buck, it was decided that the man who designed me had missed his calling and should have been a designer of women's clothes, and that if the truth were really known, he probably never went beyond the fifth grade in school anyway. I was out of service six weeks, two of which were caused by the delay in securing a parts list. No one seemed to know just where the original parts list had been safely put away. When the repairs were finally ordered, only the broken parts were ordered, no consideration being given to the rest of my condition and the blame for the breakdown was shifted to the manufacturer in making a "defective" part.

I was finally returned to service after what they called "being overhauled" and it was assumed that I was practically as good as new. There was no change in my care and since the operators didn't even take the trouble to lay a hand on me, they missed the fact that I was not properly lined up and that parts of me were running too hot. This caused my second inactive period and after that it was simply a repeat performance—just a matter of time until I was down for repairs. Finally the time arrived when it was considered more economical to replace me with a new piece of equipment. My successor arrived and was installed in much the same manner as I had been and I sat back to watch developments.

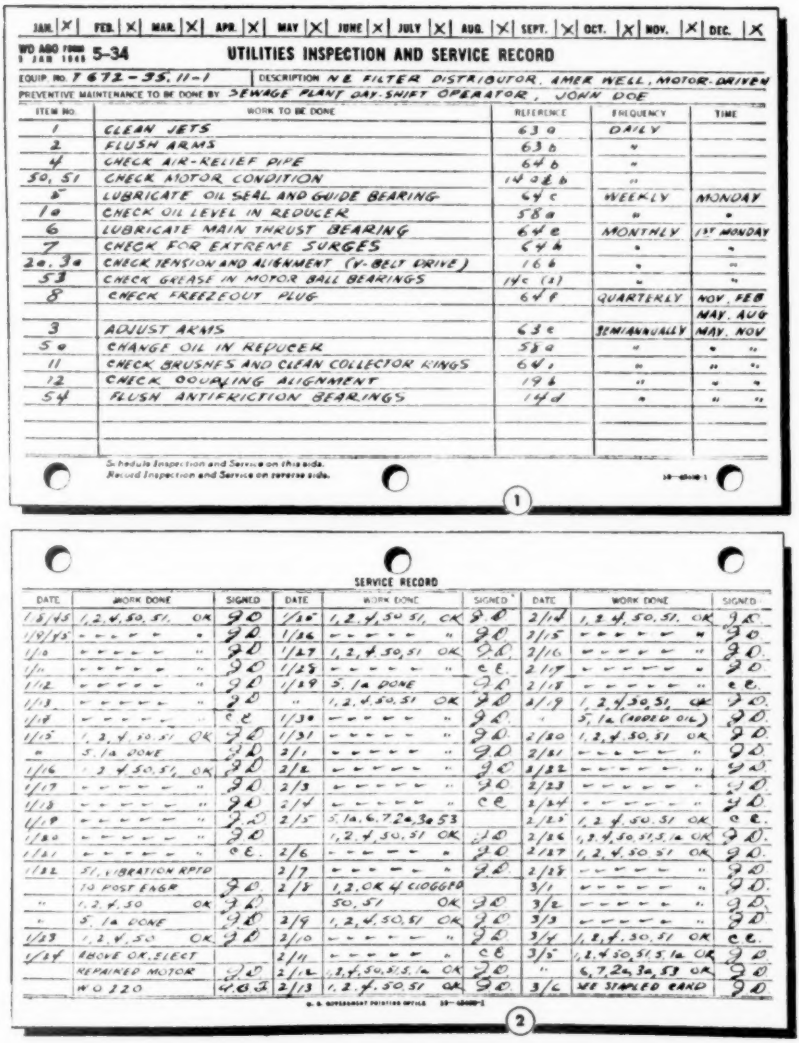
A vacancy in the operating personnel occurred when one of the operators moved to another state, and an examination was held to fill it. The new operator was an ex-service man and I could see that he knew his way around when it came to equipment. Soon after he was assigned to a regular shift I heard him ask another operator where the inspection schedule for the equipment was located and who did the work. He was told that the equipment was greased once a month and that inspection was a part of plant operation, assigned to no one in particular, whoever had time looked things over and reported his findings to the operator relieving him.

The first time the new operator worked the "graveyard shift," he was ordered to by-pass a settling tank and have things ready for the day shift to clean it. The by-pass valves were located in the pipe gallery on an overhead line and were very seldom used. The usual corrosion had taken place in one valve and it was stuck. The last time it had been used it had not seated properly and one of the operators had given it an extra hard pull to force it to close. This combination set the stage for the new operator to break the valve stem when he attempted to carry out this assignment. The day-shift operator called the supervisor and blamed the new man for being careless, and the new operator told the supervisor that if they had used a Preventive Maintenance Schedule the valve stem would not have broken since the valve would have opened and closed at regular intervals to insure its proper working condition. The supervisor, realizing that the trouble could have been avoided in this manner, asked him to explain just what such a schedule could do for the plant in general and here it what he was told!

The adoption of a Preventive Maintenance Schedule establishes responsibility for the proper care of every piece of equipment and makes the personnel maintenance conscious. The effectiveness of such a program depends upon the close cooperation of both supervisory and operating personnel in scheduling and carrying out of the assigned duties and the keeping of complete and accurate records of all work done. The working basis for the program is set up from manufacturer's specifications and the experience of the operators using the equipment.

Two identical cards are made out for each piece of equipment. One card

is for a Master File controlled by the supervisor, and the other for a Field File for the men performing the inspection and service. On the front of each card is entered a heading consisting of the name, type, number and location of the equipment, together with a brief description so that it can be readily identified, and the title of the person responsible for doing the work. The maintenance work to be done is listed by Item Number in the order of the required frequency, as daily, weekly, monthly, quarterly,



JAN. X | FEB. X | MAR. X | APR. X | MAY X | JUNE X | JULY X | AUG. X | SEPT. X | OCT. X | NOV. X | DEC. X

WD AGO FORM 5 JAN 1945 5-34 **UTILITIES INSPECTION AND SERVICE RECORD**

EQUIP. NO. 7672-35.11-1 | DESCRIPTION N.E. FILTER DISTRIBUTOR, AMER WELL, MOTOR-DRIVEN

PREVENTIVE MAINTENANCE TO BE DONE BY SEWAGE PLANT DAY SHIFT OPERATOR, JOHN DOE

ITEM NO.	WORK TO BE DONE	REFERENCE	FREQUENCY	TIME
1	CLEAN JETS	63a	DAILY	
2	FLUSH ARMS	63b	"	
4	CHECK AIR-RELIEF PIPE	64b	"	
50, 51	CHECK MOTOR CONDITION	14 3&b	"	
5	LUBRICATE OIL SEAL AND GUIDE BEARING	64c	WEEKLY	MONDAY
10	CHECK OIL LEVEL IN REDUCER	58a	"	"
6	LUBRICATE MAIN THRUST BEARING	64e	MONTHLY	1ST MONDAY
7	CHECK FOR EXTREME SURGES	64h	"	"
2a, 3a	CHECK TENSION AND ALIGNMENT (V-BELT DRIVE)	16b	"	"
53	CHECK GREASE IN MOTOR BALL BEARINGS	14c (2)	"	"
8	CHECK FREEZEOUT PLUG	64f	QUARTERLY	NOV. FEB. MAY. AUG
3	ADJUST ARMS	63c	SEMIANNUALLY	MAY. NOV
5a	CHANGE OIL IN REDUCER	58a	"	" "
11	CHECK BRUSHES AND CLEAN COLLECTOR RINGS	64i	"	" "
12	CHECK COUPLING ALIGNMENT	19b	"	" "
54	FLUSH ANTIFRICTION BEARINGS	14d	"	" "

Schedule Inspection and Service on this side.
Record Inspection and Service on reverse side.

(1)

SERVICE RECORD

DATE	WORK DONE	SIGNED	DATE	WORK DONE	SIGNED	DATE	WORK DONE	SIGNED
1/5/45	1,2,4,50,51, OK	JD	1/26	1,2,4,50 51, OK	JD	2/14	1,2,4,50,51, OK	JD
1/9/45	"	JD	1/26	"	JD	2/15	"	JD
1/10	"	JD	1/27	1,2,4,50,51 OK	JD	2/16	"	JD
1/11	"	JD	1/28	"	CE	2/17	"	JD
1/12	"	JD	1/29	5,1a DONE	JD	2/18	"	CE
1/13	"	JD	"	1,2,4,50,51 OK	JD	2/19	1,2,4,50,51 OK	JD
1/14	"	CE	1/30	"	JD	"	5,1a (ADDED OIL)	JD
1/15	1,2,4,50,51 OK	JD	1/31	"	JD	2/20	1,2,4,50,51 OK	JD
"	5,1a DONE	JD	2/1	"	JD	2/21	"	JD
1/16	1,2,4,50,51, OK	JD	2/2	"	JD	2/22	"	JD
1/17	"	JD	2/3	"	JD	2/23	"	JD
1/18	"	JD	2/4	"	CE	2/24	"	JD
1/19	"	JD	2/5	5,1a,6,7,2a,3a,53		2/25	1,2,4,50,51 OK	CE
1/20	"	JD		1,2,4,50,51 OK	JD	2/26	1,2,4,50,51,5,1a OK	JD
1/21	"	CE	2/6	"	JD	2/27	1,2,4,50,51 OK	JD
1/22	51, VIBRATION RPTD		2/7	"	JD	2/28	"	JD
	10 POST ENGR	JD	2/8	1,2, OR 4 CLOGGED		3/1	"	JD
"	1,2,4,50 OK	JD		50,51 OK	JD	3/2	"	JD
"	5,1a DONE	JD	2/9	1,2,4,50,51 OK	JD	3/3	"	JD
1/23	1,2,4,50 OK	JD	2/10	"	JD	3/4	1,2,4,50,51 OK	CE
1/24	ABOVE OK, ELECT		2/11	"	CE	3/5	1,2,4,50,51,5,1a OK	JD
	REPAIRED MOTOR	JD	2/12	1,2,4,50,51,5,1a OK	JD	"	6,7,2a,3a,53 OK	JD
	W.O. 220	W.G.J.	2/13	1,2,4,50,51 OK	JD	3/6	SEE STAPLED CARD	JD

(2)

FIGURE 1.—Equipment Inspection Record Card for Field File.

semi-annually and annually, and the time at which the inspection and service is to be done. The frequency is determined by the Manufacturer's specifications or by the careful substitution of a frequency designed on the basis of local conditions and available personnel, incorporating as far as possible those items stressed by the manufacturer. The time refers to the day of the week or month in order to generally equalize the time between inspections. On the reverse side of the card, space is provided for the date.

JAN. X | FEB. X | MAR. X | APR. X | MAY X | JUNE X | JULY X | AUG. X | SEPT. X | OCT. X | NOV. X | DEC. X

WD AGO FORM 5-34 — UTILITIES INSPECTION AND SERVICE RECORD

EQUIP. NO. T672-55.11-1 | DESCRIPTION 4" FILTER DISTRIBUTOR, AMER WELL, MOTOR-DRIVEN

PREVENTIVE MAINTENANCE TO BE DONE BY SEWAGE PLANT DAY-SHIFT OPERATOR, JOHN DOE

ITEM NO.	WORK TO BE DONE	REFERENCE	FREQUENCY	TIME
1	CLEAN JETS	63a	DAILY	
2	FLUSH ARMS	63b	"	
4	CHECK AIR-RELIEF PIPE	64b	"	
50.51	CHECK MOTOR CONDITION	14a&b	"	
5	LUBRICATE OIL SEAL AND GUIDE BEARING	64c	WEEKLY	MONDAY
1a	CHECK OIL LEVEL IN REDUCER	58a	"	"
6	LUBRICATE MAIN THRUST BEARING	64a	MONTHLY	1ST MONDAY
7	CHECK FOR EXTREME SURGES	64h	"	"
2a.3a	CHECK TENSION AND ALIGNMENT (V-BELT DRIVE)	16b	"	"
53	CHECK GREASE IN MOTOR BALL BEARINGS	14c (2)	"	"
8	CHECK FREEZEOUT PLUG	64f	QUARTERLY	NOV, FEB MAY, AUG
3	ADJUST ARMS	63c	SEMIANNUALLY	MAY, NOV
5a	CHANGE OIL IN REDUCER	58d	"	"
11	CHECK BRUSHES AND CLEAN COLLECTOR RINGS	64i	"	"
12	CHECK COUPLING ALIGNMENT	19b	"	"
54	FLUSH ANTIFRICTION BEARINGS	14d	"	"

Schedule Inspection and Service on this side.
Record Inspection and Service on reverse side.

3

SERVICE RECORD

DATE	WORK DONE	SIGNED	DATE	WORK DONE	SIGNED	DATE	WORK DONE	SIGNED
1/24	ELEC MOTOR REPAIRED W.O. 220	J.M.						
JAN	1, 2 & 50, 51 OK	J.M.						
"	5, 1a OK	J.M.						
2/8	4" CLOGGED	J.M.						
FEB	1, 2, & 50, 51 OK	J.M.						
"	5, 1a OK	J.M.						
2/19	5, 1a ADDED OIL	J.M.						

4

FIGURE 2.—Equipment Inspection Record Card for Master File.

item number, work done and the initials of the inspector. Properly arranged as to frequency, the file becomes an actual work schedule insuring complete coverage of every piece of equipment in such a manner as not to interfere with routine operation but become an essential part of it. Complete coverage of every item for each piece of equipment at or near the time and frequency designated is essential for the success of the program. The back of each card must be completely and accurately filled in and initialed by the person doing the work.

At the end of each month, the field cards are called in and all entries on the back of each card are checked against the schedule of inspections to insure that all items were properly covered. The work record on the back of the field file is then transferred to the corresponding card of the master file and becomes a permanent record.

Figure 1 shows a typical card from the Field File, set up to service a filter distributor correctly. Figure 2 shows the Master File card for the same equipment item.

By adopting and using a Preventive Maintenance Schedule the plant supervisor now has a good working picture of all equipment and can determine the extent of actual maintenance problems. He knows how well each piece of equipment is functioning, and that it has been given the required lubrication and attention. He is able to determine if the repairs made have been satisfactory or if repeated repairs to a piece of equipment indicates poor workmanship, defective material, abuse of the equipment, or actual overloading. He can anticipate, with a marked degree of accuracy, what future repairs may be needed and thus prevent a breakdown of operational functions. The efficiency, work coverage, and interest in the work assignments of the plant personnel will be reflected by the results of following this maintenance schedule.

The plant operator or maintenance man performing these services will have the satisfaction of a job well done. His knowledge of each piece of equipment, its operational functions and maintenance, will increase. He will be able to fit himself for a more responsible position and command the cooperation of the plant supervision in all operational and maintenance problems. Preventive Maintenance finds the defects while they are in the minor stage and thus forestalls major break-downs. New personnel can quickly become familiar with the types and locations of the equipment and relieve the supervision of much of the usual time required for instruction. The mutual responsibility and close cooperation between supervision and operating personnel will be reflected in cost reduction and increased efficiency.

As I said before, I listened while the Preventive Maintenance Schedule was explained and I noticed the usual reactions take place in the attitude of the supervisor. He could not deny the merits of such a system but hesitated to start such an overall change of policy, especially when it appeared to be adding additional duties to what he considered to be a full work schedule as it now existed. However, after some careful study and planning, he decided to try it. It wasn't smooth at first, and the gripes of the operators could be heard all over the plant—but it really worked! No, it's not a cure-all, but it has eliminated 75 per cent of the former headaches, and my only regret is that they didn't have this system when I was young.

That's about all there is to my story. I know that some of you will go along as you always have and keep the aspirin handy. Some of you might take the time to think it over in your spare time, if any. And perhaps one of you might possibly try it. But if my story makes it possible to save only one piece of equipment from becoming worn-out

and useless through neglect and abuse, I can feel that someone has benefited by my experience.

I'm sure that I am a good "bad example" of old fashioned maintenance, and it's up to you to bring your maintenance practices up to date. If you keep on beating your brains out doing maintenance the hard way, YOU might end up like me! Who knows?

USE OF INTERNAL COMBUSTION ENGINES IN SEWAGE TREATMENT PLANTS*

By Roy A. Hundley

Chief Engineer, Enterprise Engine & Foundry Company, San Francisco, Calif.

Frontiers are always fascinating places to investigate and invade. One of the most interesting frontiers remaining for engine application is in sewage treatment plants. It is in no way a virgin territory, for it has been successfully invaded for some years. It is, however, one of those vast areas that is being rapidly opened to engine applications and is a field in which the internal combustion engine is most uniquely and capably used. The gas available from the treatment process lends itself to most economical utilization in an engine. These engines can be used as prime movers for the generation of electricity and for pumping of either air or water.

The subject of application of engines in sewage treatment plants is one having many ramifications, each branch of which might be taken for discussion in an entire paper. Time limitations demand confining the discussion to but four of these phases.

High Temperature Cooling

High temperature cooling is defined as the type of cooling used wherein the temperature of the engine jacket water is above the boiling point of water at the normal pressure of the atmosphere. By putting the engine jackets under pressure, it is possible to have the water retain its state as that of a liquid and yet be at temperatures in excess of 212° F.

Condensation

The use of high jacket water temperatures, as a method of cooling, is rapidly becoming accepted as a very desirable condition of operation. Water in an internal combustion engine has a Dr. Jekyll and Mr. Hyde personality. It must be in the engine jacket and must be circulated at a reasonable rate. It must not be allowed to form in the combustion chamber as a condensate. There are large quantities of H_2O formed in the products of combustion. In sewage engine applications, this quantity may be as high as 1¼ gal. for each 10 b.hp.-hr. The temperature at the time of combustion, of course, causes the state of the H_2O to be that of a gas. Upon expansion, however, the gases cool and should they cool to temperatures corresponding to the dew point of the gas for the pressures encountered, condensation will occur. This condensation that may occur is caused by contact of the exhaust gas with the cylinder walls, which themselves must be sufficiently cool to cause condensation to occur. The water, if allowed so to condense, has an objectionable habit of combining with any sulfur that may be present, to form corrosive acids. The condensate, further, has a serious effect in reducing lubrication qualities of the piston and liner, and

* Presented at the 20th Annual Meeting, California Sewage Works Association, San Diego, Cal., June 18th, 1948.

should the condensate get into the crankcase, a serious sludging condition occurs in the crankcase. The effect on the lubrication of piston and liner is to accelerate, to a high degree, the rate of wear.

Control of Condensation

The obvious way to counteract the effects of such condensation is to keep all metal surfaces hot enough so that under all pressure conditions within the combustion chamber it will not be possible to reach the dew point of the exhaust gases. There are several ways of accomplishing high temperature cooling. In all cases the jacket system must be well sealed to maintain pressure. The limits of the pressure are entirely set up by engine design. Most important are the gasketed joints and packing, particularly at the bottom of the cylinder liner for engines having removable cylinder liners. For this reason, relief valves or pressure caps are used which will relieve the pressure at the established maximum. Pressures, today, are generally below 20 p.s.i., mainly because high temperature cooling has generally been applied to conventionally designed engines.

The high temperature cooling water may be passed through either conventional heat exchangers, such as shell and tube type, or through radiators, or its heat recovered by blowing down the steam that is generated. This steam can either be used, should there be a need, or it can be condensed in a conventional manner and pumped back into the jacket system. The system, when low pressure steam is utilized, is best known under the trade name of "Vapor Phase." Such utilization of low pressure steam has been successfully applied in sewage plants by extracting the steam from the engine jackets and supplementing the jacket water heat extraction by taking additional heat from the exhaust. Under such an arrangement it is possible to obtain approximately 4 to 5 lb. of steam per b.hp.-hr. at 10 lb. gauge.

Thermal Shock

Further advantages are to be gained by the use of high temperature cooling insofar as over-all engine operation is concerned. Thermal shock is frequently a source of trouble in engine operation. It generally is caused by sudden, heavy load changes. By maintaining high temperature and relatively high flow rates of cooling water, the difference between maximum and minimum temperatures of water in and out of the engine is held to within close limits and, the engine being already very hot, the effect of sudden load change is greatly minimized. Further, with high temperature cooling the specific temperature of the several parts throughout the engine is maintained more uniformly, thereby minimizing the effect of temperature differential during operation.

One of the most difficult hurdles in obtaining efficient high temperature cooling is the mental attitude of the operator whose past experience has been based on cooling water temperatures in the vicinity of 120° to 140° F. The low maintenance costs of engines operated under high temperatures, however, are rapidly breaking down this prejudice.

Torsional Vibration

Torsional vibrations occur in any power unit consisting of a reciprocating engine connected to some type of driven equipment. The rotating shaft system of any such installation has a natural frequency of torsional vibration. If the frequency of the force impulses from the prime mover should be at resonance with this natural frequency or at a harmonic of this natural frequency, serious vibrations will be built up which may cause eventual shaft failures. The speeds at which these vibrations build up are called "critical speeds." The forces causing

the building up of such vibrations may come from either the driving or the driven equipment. The manner in which the torsional vibrations manifest themselves is generally by noise in the system, particularly if there are gears located in, or connected to, the shaft system.

Critical Speeds

It is possible to calculate these critical speeds most precisely and to determine the magnitude and the range over which these vibrations may occur. With sufficient latitude given to the engine builder, it is possible in most cases to control the location of these critical speeds by altering the magnitude of the masses in the rotating system and by controlling the diameter and length of the entire connecting shafting. The responsibility for satisfactory torsional vibration-free operation is accepted by the engine builder and, with sufficient freedom in the selection of the location of the machinery and shaft size, he can present a design which will produce an acceptable condition of operation. It is necessary, however, that complete and accurate data be supplied by the manufacturers of the driven equipment, for the builder's calculations will be accurate only to the extent of the accuracy of the data given by these vendors. It is likewise desirable that such information be given early in the stages of the development of the plant in order that suitable leeway and freedom for location of equipment can be available before structural or arrangement limitations are set up.

Eliminating Criticals

It is not always possible, from an economical standpoint, to eliminate all serious criticals within the operating speed range of an application. In such a case, the location of the criticals can be controlled when sufficient freedom is given and, therefore, the harmful critical speed can be so located that it is not necessary or desirable to operate at that speed. It then becomes necessary for the operator to develop a technique of passing through the critical speed range quickly. In order for a torsional vibration to build up to a point of danger, it is necessary that the engine be operated at that point for several seconds.

Should there be a reduction or a speed-up gear between the engine and the driven equipment, there is an additional burden thrown upon the torsional analyst to provide smooth, trouble-free operation. The gear problem is one that is superimposed upon that necessary to provide a torsionally acceptable shafting system. The basic nature of the calculations, however, is similar, it being necessary to be assured that there is always a positive torque across the gears to avoid the effects of oscillating torques causing gear rattle, and resulting pounding and eventual failure. To control satisfactorily the problem of positive torque across the gear, the main factors required are the freedom to use an adequately sized flywheel, the type of coupling, and the size and length of connecting shafting.

Torsional criticals have always been present in all machinery. However, precise knowledge of the problem and the ability to analyze it are fairly new. It received its greatest attention as a result of difficulties encountered in German submarines in World War I. Similar to high temperature cooling, it is frequently difficult to convince operators, whose background has been confined to older, heavier, slower speed operating machinery, that such a thing as torsional vibration is a real and absolute condition over which the engine builder has no specific control other than to analyze and design the equipment so that all conditions of operation are entirely acceptable and vibration free. Torsional vibration is not a condition which the designer either puts in or takes out, but is a character-

istic of the type of equipment used. It should be understood that all forms of shaft vibration are not torsional criticals. The most common vibration trouble, which is frequently charged to torsional vibrations, is shaft whipping. This type of vibration is caused by the natural deflection of the shaft in its mounting between two bearings, and it is most satisfactorily remedied by adding another line shaft bearing.

Safety Controls

Safety controls on engines, or any operating piece of equipment, are essential as a form of insurance. Like most insurance, safety control requires investment, the magnitude of which is proportional to the degree of protection considered necessary or desirable. It is necessary for the proper functioning of an internal combustion engine that there should be an adequate quantity of water for cooling in order that the maximum temperature considered safe for operation will not be exceeded. In addition, it is necessary that the engine have an adequate quantity of lube oil at sufficient pressure and at temperatures not exceeding the point that may cause breakdown of this oil.

No mechanical device has yet been conceived that is perfect. To a great extent the degree of satisfactory operation obtained depends upon the quality of plant supervision and maintenance provided by the plant engineer. Accordingly, the human element is a very important factor in the picture of satisfactory operation. The frequency of inspection and the quality of operation and operational care required are inversely proportional to the amount and type of protection desired by safety devices.

Even though it may be considered desirable to have maximum protection, the application of safety devices must be used with discretion. It is possible to go thoroughly overboard by having protective devices for protective devices, ad infinitum.

Pressure and Temperature Controls

Generally it is sufficient in the most simple form of protection to have a switch device operated by the lube oil pressure and a switch device operated by high temperature in the cooling water system. Should the lube oil pressure fall below a predetermined minimum safe figure, the closing of this switch will "make" a circuit which will sound an alarm and light a lamp to indicate the source of trouble being announced by the alarm. Similarly, with a switch in the cooling water system, should the temperature exceed that value which is considered safe, the switch will be closed and similar warning occur. If there is the possibility that an attendant may not be on hand at all times to do something about such abnormal conditions, it is then desirable that such contactors be so connected to the source of fuel that the fuel is cut off from the engine, thereby stopping the engine.

It is not unusual to provide dual contacts for the two conditions indicated previously. The first of these will sound an audible alarm and light the proper indicating light to point out the source of difficulties. The second will be set at slightly higher temperature, in the case of the water, and slightly lower pressure in the case of the oil, for shutting down the engine. This further illustrates the necessity for determining the amount of premium to be paid for the insurance desired.

The statement made regarding the perfection of the engine applies equally well to the protective devices. They, too, are subject to improper operation and, rather than duplicate the equipment, it is desirable to check the operation of the system periodically. Many alarm systems have test circuits to indicate the correct functioning of the lights and howlers. However, it

must be remembered that the pressure and temperature devices mounted on the engines themselves should occasionally be removed and checked for proper operation.

Although generally not used to actuate safety devices, quantity of water and oil is important. It is possible to apply level indicators to actuate alarm circuits which will signify insufficient quantity of these fluids for safe operation. The major problem again, is how far it is considered necessary to go in setting up alarm systems and safety devices.

Speed Safety Controls

Most rotating and reciprocating machinery has maximum safe limits of speed. It is desirable, therefore, that additional protection be provided for controlling the speed of the prime mover, should its normal speed control devices become inoperative. The most satisfactory method of control is to provide an additional governor which is completely independent in its action from that of the normal governor. This auxiliary governor should be set so that, at approximately 10 per cent above the anticipated normal speed of the engine, it will be completely shut off the fuel supply.

On electric generating units it is also necessary to tie into the switchboard with an overspeed protective mechanism, in order that the main circuit breaker will take the engine and generator off the board. This becomes necessary because it may not be malfunction of the engine that causes the overspeed, but an electrical difficulty which could convert the generator to a motor, thereby driving the engine at excessive speeds. Only by opening the main circuit breaker can the engine be protected from such overspeeds from this source.

Variable Speed Controls

There are applications of internal combustion engines in sewage disposal plants where the amount of work to be done varies over fairly large ranges throughout the period of a normal cycle of operation. Pumping water from digester tanks is an example. The rate of flow into the tanks may vary over a fairly large range, and it is desirable that the level in the tanks be maintained at a fairly constant point. It becomes desirable then to provide devices that effectively read or indicate the liquid level in the tank and transmit this information, as it were, to the engine so that the pumping rate out of the tank will vary as the rate of inflow.

Because compressed air is available for starting, air becomes a very suitable source of energy to operate the mechanism for accomplishing speed and load changes. A device which is referred to as a "master" is mounted at or near the tanks and, in turn is operated by a float. This float is mounted on the end of the lever which changes the position of the mechanism within the master unit as it rises and falls. A device called a "slave" is attached to the engine and controls the governor. The master can be considered an air pressure regulating valve. The position of the water level in the tanks is transmitted through the float and linkage, actuating the mechanism in the master which in turn changes the pressure in the air system. The higher the level of water, the greater the pressure in the system. This greater air pressure is transmitted to the slave unit, which is basically a cylinder operated against a fixed coil spring. Increased air pressure moves the levers on the slave which in turn transmits this motion to the engine governor, thereby controlling the speed. By increased speed, the pumps displace greater quantities of water, thereby meeting the requirements indicated by the rising level in the tanks.

It is necessary for such a control system to maintain, between maximum and minimum air pressure con-

ditions, a difference of no more than 20 to 30 lb. per square inch. The size of the diaphragm or piston, or the magnitude of the spring can be so designed that the resultant force is sufficient to operate the engine governor and linkage. As in most engine speed controlling devices, a differential is required to avoid hunting or unstable speed control. This differential in the pumping operation is obtained by the height of the liquid in the tanks from which the liquid is being pumped.

Synchronizing Speed Controller

It is frequently necessary to have more than one engine pumping from the same tank, which brings about a condition whereby there may be but one master and several slaves. Fundamentally the system is not increasingly complicated because of such arrangement, but the problem of synchronizing the several engines to approximately the same speed becomes mandatory. To accomplish this synchronization an auxiliary air cylinder is designed into the slave units. The unit for operating the auxiliary cylinder of the slave units is controlled by the plant operator. Where there may be a speed control by the major "master-slave" combination of several hundred r.p.m., the auxiliary cylinder of the slave unit has a maximum control of approximately plus or minus 20 r.p.m. Generally, once set all engines will maintain synchronism to a sufficiently close degree to obviate the requirement of continuous adjustment over the speed range.

Supercharging

The ability of any engine to produce power is a direct function of the amount of air and fuel that it is possible to get into the working cylinders, the amount of air being the most critical. Prior to supercharging, the ability to overload an engine was frequently limited by the basic design of the engine itself, insofar as the valves and manifolding were concerned. This is more the case with the spark ignition carburated type engine than with the normally aspirated diesel engine. Manifolding on a carburated engine can be so designed that even with wide open throttle the maximum loading would be such that little harm could be forced upon the engine by overloading. In a diesel engine, on the other hand, operating under conditions of excess air in considerably higher percentages than a spark ignition engine, it is possible to increase the fuel rate to the point that overloading results, the warning being a smoky exhaust and high exhaust temperatures, indicating poor combustion. Normally aspirated engines, of either sparks ignition or diesel type, have satisfactorily proved themselves as being capable of operating 24 hours a day, 7 days a week, at 80 p.s.i. B.M.E.P. At this rating, there is still an acceptable overload capacity for short periods within any one day.

The advent of supercharging has brought about the possibilities of overloading engines to a marked degree. Maximum fuel rate rather than the quantity of air becomes the limiting condition of load control. Dual fuel supercharged engines increase a step further the possibilities of engine overload by virtue of designing into the engine two fuel systems from each of which it is possible to obtain 100 per cent rated load. Approximately 120 p.s.i. B.M.E.P. is considered a basic normal rating for continuous service. Higher output engines have been designed and are being operated, but these are generally used for those installations requiring intermittent duty at higher ratings.

The manufacturer of engines provides suitable protective devices to limit the fuel rate on the engines as built when they leave the factory. These protective devices should be respected and considered by operators as

devices provided for protection and as insurance for long-time, trouble-free operation. As with the alarm type of protective device, all overload protective devices should be observed and checked at regular intervals.

ELIMINATION OF STORM WATER FROM SANITARY SEWERS AT WADSWORTH, OHIO *

By Frank G. Randall

City Engineer, Wadsworth, Ohio

In 1931 the city of Wadsworth, Ohio was confronted with a serious sewer problem. Being served by a separate sewer system, storm water had become an increasingly serious burden to the sanitary sewers. These were often surcharged, and the sewage treatment plant was flooded out during periods of heavy rainfall. It became apparent that drastic steps were necessary to correct a condition that made the sewers inadequate to carry the excessive rates of flow as well as making the sewage treatment plant entirely incapable of serving its intended purpose.

The onset of this problem was not rapid; rather, it was so gradual that few realized the extent of the sanitary sewer system. This was naturally so in the case of Wadsworth, for the terrain is quite hilly. Otherwise the first indications would have resulted in basement flooding and a never-ending number of complaints from those damaged.

The cause for misuse of the sanitary sewers might be attributed to several causes. The most important are: (1) lack of inspection for making new connections to the sanitary sewer, and (2) lax enforcement, or possibly the lack of a regulatory ordinance requiring proper connection and sanitary and storm sewers, as well as authority for compliance thereto.

The city of Wadsworth eventually realized that it was confronted with improvements in the way of relief sewers and additions to the sewage treatment plant or a definite program of storm water elimination from the sanitary sewer system. Having a separate sewer system reasonably adequate for sanitary sewage flows, the correction of the storm water problem was the choice. However, the municipal officials realized that, first, a certain amount of educational work was necessary to inform the citizens of the reasons for this program and, second, that a firm stand must be taken toward uncooperative citizens to assure its success.

Location of Improper Connections

To establish proof of improper connections to the sanitary sewer system, sections of the municipality were surveyed. Rubber balls obtained from a rubber specialty manufacturer were purchased in two sizes—½ in. diameter of sponge rubber, and 1½ in. diameter, hollow and of white rubber. These were numbered with waterproof black India ink which did not rub off with use.

With a two-man crew, one or the other size balls were dropped into downspouts, and record was made of the number used at each particular residence. At the same time a ball was dropped in the basement drain if there appeared to be a question of whether or not it was connected into the storm sewer. The hollow balls were used wherever possible, as it was easier to collect these than the smaller

* Presented at 22nd Annual Meeting of the Ohio Sewage and Industrial Wastes Treatment Conference, Dayton, Ohio, June 23-25, 1948.

ones. Special cases necessitated the use of the small ½-in. balls.

Balls recovered at the sewage treatment plant were noted floating on the liquid surface. These were generally collected in the primary tanks. Storm sewer outlets and the receiving streams were inspected frequently to collect those expected to show up there.

Corrective Action

The manner of correcting improper connections was simple and forthright. First, the city adopted a suitable regulatory ordinance establishing rules for inspection of connections to the sanitary sewer system, with definite authority for enforcement. Second, records were kept as to where these checks were made, the number of the ball used at each location as well as the time and place of the recovery of the ball. No objection to placing of rubber balls was experienced.

In cases where recovery of the rubber ball indicated misuse of a sewer, the resident was advised by letter that 30 days would be granted for him to make correction under city supervision and in accordance with the regulatory ordinance. A form letter was used, and this was signed by the mayor. Also in this letter it was stated that if compliance was not accomplished within the allotted time the city would do the work and assess it against the owners.

The program was carried on over a 2-year period, and only in a very few of the cases was it necessary for the city to undertake the corrective work.

It is interesting to note that usually not over 2 or 3 days were required to recover the rubber balls at the sewage treatment plant. In some cases the rubber balls were lost and rechecks were required.

The success of the Wadsworth program was gratifying in that the use of the sanitary sewer system was restored reasonably well to the purpose for which it was intended, and afterwards the sewage plant rarely experienced more than 2½ times the dry weather rate of flow even during extended rainy periods. Possibly a low amount of infiltration favored this accomplishment.

In spite of close inspection of the sewer connections there has been some indication of sewer misuse in the past year, so another survey of areas known to produce the heavier wet weather flow increases will be made as time permits.

Storm water elimination from a sanitary sewer system is an endless problem but one that can be controlled by diligent work on the part of the city.

ELIMINATION OF STORM WATER FROM SANITARY SEWERS —A DISCUSSION

By Homer Knox

Principal Assistant Engineer, Ohio Department of Health, Columbus, Ohio

The average domestic sewage flow from a dwelling does not generally exceed 40 to 50 gal. per capita daily. However, in determining the sizes of sewers required, a maximum rate of sewage discharge is generally assumed as about 300 g.c.d.; this is equivalent to a flow of about 0.2 g.p.m. For the average family this is equivalent to 0.7 g.p.m.

The average roof area per dwelling is about 900 sq. ft. Assuming a rainfall intensity of 2 in. per hour, the roof drainage from a dwelling is 18.75 g.p.m. or 27 times the maximum rate of sewage from the dwelling.

The capacity of an 8-in. sewer, flowing full on a minimum grade of 0.4 per cent (using $n = 0.013$), is 0.7 c.f.s. or 315 g.p.m. Hence, roof connections

from only 17 houses could cause this sewer to flow completely full. This same sewer would be capable of receiving the sewage flow at a rate of 300 g.c.d. from a tributary population of 1,500 persons living in 428 dwellings.

The foregoing figures forcibly illustrate the effects that even a few roof drains can have on a system of sanitary sewers.

Basement flooding caused by surcharged sanitary sewers probably results in ten times as many complaints as all other features of a sewer system. The complainant often does not know that he himself is contributing to the problem.

The residential district cannot afford to install sewers of sufficient size to receive both sanitary sewage and roof drainage. It is cheaper to install separate systems of sewers for sanitary sewage and storm water. Some municipalities are now requiring that sanitary sewers be designed to receive a flow of 1.0 c.f.s. or even 1.5 c.f.s. per 100 acres. Assuming a population of 20 persons per acre, a flow of 1.5 c.f.s. per 100 acres is equivalent to a rate of about 500 gal. per capita daily.

Such increased allowance admits the probability that storm water connections to the sanitary sewers may not be completely eliminated. Such increased allowance in sewer capacities is not the answer to overloading of sewers. The only satisfactory solution to this problem is the proper inspection of sewer connections to prevent any roof drains or other storm water from discharging into the sanitary sewers.

INTERESTING EXTRACTS FROM OPERATION REPORTS

"Do the best you can with what you've got—
where you are."
—*KVP*

Attention operators! It will be appreciated if copies of all annual reports of both large and small plants are sent to the Federation office for abstracting in this section of the Journal. Carbon copies of typewritten reports will be promptly returned on request. Please direct annual reports to: Federation of Sewage Works Associations, Room 325, Illinois Bldg., Champaign, Ill.

Fifteenth Annual Report of the Minneapolis-St. Paul Sanitary District for the Year 1947 *

By Kerwin L. Mick
Chief Engineer and Superintendent

A total of 44,870 m.g. of sewage was treated by the plant during 1947, averaging 125.6 m.g. per day. A total of 36,663 cu. ft. of screenings and 162,270 cu. ft. of grit were removed. During the year 120,092 tons of filter cake were produced, containing 36,633 tons of dry sewage solids.

Plant Loading

From an estimated tributary population of 900,000 in 1947, the following per capita values obtained:

(1) Sewage flow, g.p.c.p.d.—139.

* For last previous extract see This Journal, 19, 6, 1075 (Nov. 1947).

(2) Suspended solids, raw sewage, lb. per cap. per day—0.33.
(3) Biochemical oxygen demand, raw sewage, lb. per cap. per day—0.23.

Assuming 0.17 lb. of 5-day B.O.D. per capita per day for domestic sewage only, the population equivalent of the sewage and wastes received at the plant during 1947 was 1,230,000, or 36.6 per cent greater than the estimated population of 900,000. Industrial wastes account for the major part of this difference, and according to these figures would amount to 26.8 per cent of the pollution load on the plant.

Vacuum Filtration

Sludge from the settling tanks is pumped to concentration tanks where it is held approximately 1 day for concentration. The effectiveness of these tanks is indicated by the average increase in solids content from 8.03 per cent in the raw sludge to 9.09 per cent in the concentrated sludge. In addition, these tanks serve as a means of storage and level off variations in solids content due to rapid changes in sludge characteristics. A total of 91.4 m.g. of concentrated sludge was filtered during the year. The average solids content of the filter cake was 31.5 per cent, and 64.0 per cent of the solids were combustible.

Sludge Conditioning Chemicals

Chemicals used for sludge conditioning during 1947 were ferric chloride and ferric sulfate, expressed as ferric chloride, fed at an average dosage of 1.28 per cent of the weight of the dry sludge solids, and lime at an average dosage of 3.69 per cent, expressed on a calcium oxide basis.

Ferric chloride was used in this plant for the first 9 years of operation, but in June of 1947 it became necessary to to change over to ferric sulfate (Ferri-Floc), no bids having been received on ferric chloride. This involved using a new chemical with entirely different handling and feeding characteristics, ferric sulfate being supplied in the dry granular form in bulk carloads while ferric chloride had been supplied in solution form in tank cars.

For the first 5 months of 1947, during which the iron coagulant used was principally ferric chloride, the average dosage was 0.91 per cent $FeCl_3$ and 2.53 per cent CaO. For the last 7 months of the year, when ferric sulfate was used, the average dosage was 1.52 per cent ferric sulfate, expressed in terms of ferric chloride for the purposes of comparison, and 4.45 per cent of CaO. The average dosage for the entire year was 1.28 per cent iron as $FeCl_3$ and 3.69 per cent lime as CaO.

Ever since the regular use of ferric sulfate was begun in June, special endeavor was made to improve the handling, feeding, dissolving, and mixing of this new chemical in order that it might more closely approach ferric chloride in effectiveness and economy. That these efforts were beginning to show results in indicated by the records for the last 2 months of the year, when the dosage of ferric sulfate, expressed as ferric chloride, dropped to an average of 1.02 per cent and the lime dosage dropped to an average of 2.96 per cent. On October 30 a change had been made in the point of addition of the ferric sulfate to the sludge which evidently greatly improved the mixing and final filterability of the sludge. Since that date the ferric sulfate solution has been added to the sludge in the discharge hopper of the bucket elevator, rather than in the conditioning tank as formerly done with both ferric sulfate and ferric chloride.

In addition to the regular iron and lime coagulants, an 11-day trial-run was made in October using a third chemical with the trade name "ECCO Suspension Catalyzer" which had been tried in Michigan with some apparent success. The data from this short trial

run indicated that the use of this third chemical might permit some reduction in ferric sulfate dosage, with possibly a small saving in over-all filtration costs. It was planned to conduct a more extended trial of this chemical in 1948.

Filter Cloth Life

The average life of filter cloths during 1947 was 413 hours, which compares with 501 in 1946, 339 in 1945, 474 hours in 1944, 461 hours in 1943, 493 hours in 1942, 355 hours in 1941, 326 hours in 1940 and 170 hours in 1939. The somewhat shorter average cloth life in 1947 may have been due to the higher chemical dosage required for conditioning the sludge. Also, the use of ferric sulfate appeared to produce a wetter filter cake and to require more frequent washing of the filters and more frequent acid baths. However, by the close of the year the successful endeavors to reduce the chemical requirements apparently also resulted in somewhat increased cloth life, the average life for the last two months of the year being 472 hours.

Acid Cleaning of Filter Drums

Further improvement was made in the procedure for acid cleaning of the filter drums, particularly for the division strips and interior pipe lines, by revolving the drum in a bath of inhibited hydrochloric acid. The new innovation consisted of merely reversing the direction of rotation of the drum by switching the wires on the drive motor, thereby causing the drum to act like a waterwheel to lift some of the acid out of the filter pan and allow it to drain back through the division strips and interior piping to clean out the carbonate scale. The filtrate line as it leaves the filter was tapped for a hose connection to drain the acid back into the filter pan, thus establishing a continuous circulation of acid and eliminating the use of an acid pump which formerly had been necessary in cleaning the 650 ft. of 1-in. piping per filter.

Filter Washing

Various frequencies of filter washing were tried out in the range between the former practice of washing the filters at least once every 4 hours and continuous washing. By the close of the year it had been tentatively concluded that continuous washing does not appear to be economical, at least not at wash water pressures of 60 to 75 lb. per sq. in. The controlling factor seemed to be the excessive wear on the filter cloths from the water sprays at the above pressures, and surprisingly enough the cloths seemed to "blind-out" sooner under continuous washing than they do under intermittent washing. The continuously-washed cloths had to be changed after 85 to 290 hours of service.

After trying various washing frequencies, the following practice has been in effect since November, as representing the most economical procedure based upon the data available to date. The filters are washed at least once each hour, for at least one revolution of the drum (about 5 minutes), and may be washed oftener under difficult filtering conditions at the discretion of the operator. Thus the maximum interval between filter washings has been progressively decreased from 24 hours or longer, when the plant started operation in 1938, to continuous washing with plant effluent at 30 to 50 lb. per sq. in. in 1945, and now up to one hour as the practice at the close of 1947.

Incinerators

During the year 1947 a total of 119,848 tons of filter cake containing 37,778 tons of dry solids was incinerated. This required 363,635 kw.-hr. of electricity for power, amounting to 9.6 kw.-hr. per dry ton, and 22,516 gal. of fuel oil, amounting to 0.6 gal. per dry ton. The fuel oil was used mainly

for starting the incinerators and taking them out of service as well as for holding temperatures during short periods when incineration was not required. A total of 13,599 tons of dry ash was produced, averaging 38.1 tons per day. The average tonnage of dry cake solids handled by each incinerator daily for the year was 37.7 tons. The average tonnage of combustible solids per day was 24.1 tons per incinerator, or 1.0 ton per hour.

During 1947, reversing switches were installed on the conveyor belt drives (main incinerator belts) to permit reversing the belts when filter cake plug-ups occur, to facilitate rapid relief of this condition and promote more uniform incinerator temperatures.

Miscellaneous

The practice of conducting planned shutdown of the treatment plant during period of high water in the spring and fall to insure dependability of operation during the critical summer and winter months was continued. In addition to the inspection of all the equipment at the plant, such shutdowns are necessary to inspect that intercepting sewers and control stations which are inaccessible except during such times.

Use of Sludge for Fertilizer

During 1947 none of the fresh sludge cake production was issued to farmers for fertilizer purposes, the State Department of Health having declined to approve the continuance of this practice which had been carried on for a number of years on an experimental basis during the fall and winter months only. However, small users are still permitted to obtain some of the aged cake which has been stock-piled for 2 years or more before use.

Sludge Meter Tests

The quantity of raw sludge pumped was formerly calculated from the measurements obtained from sludge Venturi meters, but tests conducted during the latter part of December, 1946, and the early part of January, 1947, indicated these sludge meters recorded high results. When tests were performed with air, sewage, and sludge, the following was observed to occur:

1. High readings were obtained with air which indicated that the sludge meters recorded the air volume passed through and consequently would also record any gas contained in the sludge as a false sludge volume.
2. A correct volume of sewage was found to be delivered by the pumps when the height in the receiving tank was checked against the meters.
3. When sludge was pumped a high reading was recorded as compared with the actual volume in the receiving tank.

The sludge Venturi meter readings were discontinued due to the results of these tests and the raw sludge quantities calculated on a volumetric basis from meter readings which indicate the height of sludge in the concentration tank.

Investigation of Dilution Waters Used for B.O.D. Test

In this study it was desired to obtain comparative B.O.D. results upon a number of sewage and river samples using the former standard sodium bicarbonate water and buffered mineralized phosphate (Standard Methods Committee Formula C) water. Several comparative studies were made as follows:

(a) Bicarbonate water vs. Seeded Formula C water.
(b) Bicarbonate water vs. Non-Seeded Formula C water.
(c) Seeded Formula C water vs. Non-Seeded Formula C water.

Certain periods of this investigation were varied by studying the results obtained by using Formula C water supplemented with ammonium sulfate (now recommended in Standard Methods, 9th Edition) compared with bi-

carbonate water, and Formula C water without the addition of nitrogen.

The results obtained in the various comparisons made during this investigation showed that in B.O.D. determinations of sewage samples from this plant, the average B.O.D. values of both raw sewage and effluents were the same whether using bicarbonate water or the mineralized phosphate water (with and without supplemental nitrogen). Seeding of the dilution water showed very little effect on the final results.

However, results obtained in comparing river water samples showed the mineralized phosphate water without supplemental nitrogen and seed gave 5- and 10-day values in closer agreement with bicarbonate dilution water and undiluted river water than with the nitrogen-supplemented mineralized phosphate water. The latter water tended to yield excessively high 10-day values in the majority of river samples studied.

On the basis of the foregoing studies this laboratory is now using the mineralized phosphate water, without supplemental nitrogen, in B.O.D. determinations, but further comparative studies are contemplated for different

TABLE I.—Summary of Operating Data for 1947 at Minneapolis—St. Paul, Minn.

Item	Average
Rainfall (in.)	26.60
Estimated tributary population	900,000
Equivalent population (0.17 lb. B.O.D./capita)	1,230,000
Sewage flow (m.g.d.)	125.6
Screenings (cu. ft. per m.g.)	0.8
Grit removed:	
Amount (cu. ft. per m.g.)	3.6
Volatile solids (%)	10.1
Dissolved oxygen (p.p.m.):	
Raw	0.60
Settled effluent	3.85
Settling tank detention (hours)	0.9
Suspended solids (p.p.m.):	
Raw	315
Settled	86
Per cent removed	72.5
B.O.D. (p.p.m.):	
Raw	200
Settled	120
Per cent removed	40
Raw sludge:	
pH	6.0
Total solids (%)	8.03
Volatile solids (%)	68.9
Thickened sludge:	
pH	5.9
Total alkalinity (p.p.m.)	1,150
Total solids (%)	9.09
Volatile solids (%)	67.4
Filter cake:	
Total solids (%)	31.5
Volatile solids (%)	64.0
Production (wet tons per day)	336.4
Production (dry tons per day)	106.0
Conditioning chemicals:	
Per cent CaO (lb. per 100 lb. dry sludge solids)	3.69
Per cent $FeCl_3$* (lb. per 100 lb. dry sludge solids)	1.28
Sludge filter rate:	
Lb. per sq. ft. per hour (wet cake)	10.4
Lb. per sq. ft. of filter area used (wet cake)	0.91
Incineration:	
Average daily tons	67.7
Moisture evaporated per ton of combustibles (tons)	3.7
Ash (dry tons average daily)	38.1
Power (kw.-hr. per ton dry solids)	9.6
Fuel Oil (gal. per ton dry solids)	0.60
Filter cake disposal:	
Fertilizer (dry tons, total)	75.3
Incinerated (ave. dry tons daily)	105.8
Operation and maintenance costs:	
Total ($)	429,285.67
Per m.g. treated ($)	9.56
Sludge disposal (cost per dry ton) ($)	4.74
Salaries and wages (% total)	65.9
Materials and supplies (% total)	19.9
Power and light (% total)	5.9
Miscellaneous (% total)	8.3

* Ferric chloride used January through May. Ferric sulfate used June through December. Percentages of ferric sulfate calculated to ferric chloride.

periods of sewage and river flow conditions.

Increased Costs

Increased payroll salaries account for 58 per cent of the total increased cost. Increased cost of materials and supplies account for 27.5 per cent of the total increased cost. An increase in miscellaneous expenditures (which includes pension, insurance, city water, travel, telephone and telegraph, etc.) accounts for 10.6 per cent of the total increased cost, while a 3.9 per cent increase in power cost accounts for the balance of the total increase. Operation costs increased 25 per cent for the year 1947 as compared with 1946, while maintenance costs increased 10 per cent. From these and other figures it is evident that the principal factors in the increased cost were: (1) higher payroll salaries, (2) higher prices for materials and supplies, (3) increased maintenance work as the plant grows older, and (4) increased quantity of sewage and sludge treated. In 1947 there was a 9.1 per cent increase in both the sewage volume treated and the sludge solids removed, as compared with 1946.

While salaries and wages for both operation and maintenance have increased considerably, their relationship in terms of percentage of the total cost has remained relatively uniform. In other words, salaries have not increased out of proportion to other costs.

Mississippi River Bottom Studies

To summarize the river bottom studies, it appears in general that the bottom deposits have become considerably stabilized throughout the entire river stretch covered by this survey. The old deposits yet remaining are being gradually digested and silted over so that the oxygen demand exerted by them is substantially reduced compared to previous years. However, the deposits still have an appreciable potential oxygen demand which may be exerted on the overlying waters and thus affect the maintenance of desirable oxygen conditions during summers of high river water temperatures.

Table I is a summary of the 1947 operating data.

1947 Annual Report of the Detroit, Mich. Sewage Treatment Plant for the Fiscal Year Ending June 30, 1947 *

The Detroit sewage treatment plant serves not only the City of Detroit, but also 21 communities outside the city boundaries. The total population served by the Detroit plant is estimated at 2,400,000.

Pumping Station

Routine pump-downs of the interceptors have kept them fairly free of large accumulations of grit and other debris, thus aiding in prevention of overloading the collecting equipment during storm periods.

The practice of maintaining higher intercepter levels has resulted in further decreasing power costs during the year from 113 kw.-hr. to 112 kw.-hr. per million gallons pumped.

Rack and Grit Building

The second year's trial of returning ground screenings to the sewage flow has been only partially successful, due to the gathering of the ground-up rags in bundles large enough to be caught in the bar racks the second time. A change in the discharge piping from the grinder has been laid out to prevent this accumulation. 8.4 tons of screenings were sent direct to the incinerators without being ground.

* For last previous extract see THIS JOURNAL, **20**, 1, 125 (Jan. 1948).

The influent sampling lines has now been relocated to deliver a continuous sample of the incoming sewage to the laboratory at all times.

Sedimentation Tanks

This year the main collector chains on one tank have been turned over due to the wear on one side after 7 years of service. It is expected that at least 3 years of additional service will be obtained from these chains, with a possible maximum of 5 years before new chains will have to be installed. Since each of the eight tanks contain over a mile of such chain, this saving becomes a sizable item.

The handling of sticks in grease skimmings continues to be a difficult problem for the small grease pumps. To overcome this trouble a larger size Scru-peller pump has been installed in place of the original one. For the last 8 months this larger pump has ground up 99 per cent of the sticks that have entered it. This evidence is conclusive enough to warrant complete replacement of the smaller pumps as soon as the new equipment can be purchased.

Digester

The supernatant liquor is no longer drawn off to the Filter Building to be mixed with the raw sludge there, but is now drained directly to the four west sedimentation tanks. It is expected that lower filtering costs should result from this change. Due to the high rate of digestion there is no well-defined supernatant. The minimum solids content approaches a thin sludge.

Sludge Filtration

The sludge filtering processes have undergone several refinements which have made operations simpler and results more accurate, with attendant savings in costs. These changes are: (1) automatic batch dilution of ferric chloride are used; (2) substitution of liquid carbide lime for dry pebble lime; (3) closer proportioning of lime to sludge by connected feeders.

The use of diluted ferric chloride permits finer adjustments or dosage changes and a wider dispersion of this coagulating material in the sludge. This and other factors have resulted in the lowest ferric dosage percentage since the plant started.

The difficulty of obtaining high calcium pebble lime in sufficient quantities and at the proper time intervals has made it necessary to switch over to the use of carbide lime. This carbide lime is a liquid waste product from the manufacture of acetylene gas. It is hauled in by tank truck from a nearby gas generating plant at a worthwhile saving. Two pebble lime bins have been altered to receive and store this material until used. Two replaced grease pumps are being used to pump the carbide lime from the tank truck to the elevated bins.

The use of the liquid carbide lime has made it possible to proportion the lime to the amount of sludge much closer than could be done heretofore. A feeding valve is connected to the sludge elevator drive and thus feeds a definite amount of lime for each revolution of the bucket elevator shaft.

The gradual switch-over to carbide lime began in November. It was not until April that this lime was used for all filtration for a full month. The dosage was high at first, but gradually decreased as the kinks in the feeding devices were removed. Since March no pebble lime has been used, although two full bins are kept on hand for stand-by use.

The use of muriatic acid for cleaning filters has continued. The circulation of acid has been improved by using a spare ferric chloride pump as a portable unit. This is connected to the valve head of the filter being treated.

Filter drain lines and the filtrate

line to the intercepter were cleared of a very heavy lime scale by means of air-driven rotary cleaners.

Incinerators

The preheater units of No. 4 and No. 5 incinerators have been dismantled. The motors and fans from these units have been sold and the heat exchangers are offered for sale.

Gas Engine

The gas engine, operated on sludge gas, has run a total of 6,559 hours for the year. During that time 1,144,700 kw.-hr. have been generated for plant use, an increase of 511,000 kw.-hr. over the previous year. This is 6.1 per cent of the total amount of electrical energy required.

Chlorination

The average chlorine demand of the sewage dropped from 7.77 to 6.67 p.p.m., and the total amount used was 587,745 lb. less than the previous year, although the total sewage pumped has increased. Alteration and additions to the chlorinators and meters have been completed.

Laboratory

Twenty-four-hour, seven-day-per-week control of chlorine application has continued to be the prime function of the laboratory during the past year. A rather extensive river bacteriological sampling program was carried on during the summer of 1946. Nearly 2,500 samples from the Detroit and Rouge Rivers were collected and examined during the past year.

The effect of heating of sludge prior to conditioning was also investigated, and work was started to determine effect on sedimentation of returning sludge prior to sewage settling. About twenty separate reagents were investigated for possible use for free chlorine indication in the chlorine demand test. This is the primary laboratory problem at the moment, and research on this problem will be continued.

Experiments

The filtering of heated sludge was given a 43-day trial during May and June. Live steam was introduced into the sludge sump prior to conditioning. Various increases of temperature were tried within the limits of the evaporator to provide make-up water for the boiler. Slight differences in dosage percentages were noted—sometimes below and sometimes above those of the control filters, but never great enough to compensate for the use of steam. Uniform production of a good filter cake resulted to a greater extent from heated than from unheated sludge.

A second feeding hole was provided on No. 2 incinerator and some teeth changes made to give better distribution of the wet sludge cake and to retain it longer on the upper hearths. The second feeding hole did not give as good cake distribution on the top hearth as the teeth changes did. A group of reverse teeth on a lower hearth had to be changed back to the original pattern to prevent the continual moving back and forth of the same material and the consequent piling up with little or no lateral movement.

Miscellaneous

Through the War Assets Administration it has been possible to purchase machine tools at greatly reduced prices. These machines included a 16-in. lathe, surface grinder, milling machine, 400-amp. welder, drill press, punch press, arbor press, straightening press and hoists. These machines will be used to set up a suitable machine shop at the sewage plant. Delays and the expense of sending out the work to various city machine shops can thus be avoided.

TABLE II.—Summary of 1947 Operation Data at Detroit, Mich.

Item	Average
Rainfall, total (in.)	29.68
Sewage temperature, av. (°F.)	62
Estimated connected population	2,400,000
Sewage pumped (m.g.d.)	346.0
Solids removed:	
Grit (tons):	
Wet	19,392
Dry	9,879
Volatile	3,643
Wet sluiced	4,329
Tank scum (tons):	
Wet	1,471
Dry	1,023
Volatile	943
Suspended solids (tons):	
Dry	56,946[1]
Volatile	38,325
Total solids (tons):	
Dry	67,854
Volatile	42,912
Analytical data:	
Suspended solids (p.p.m.)	
Influent	207[1]
Effluent	95
Per cent reduction	54.1
B.O.D. (p.p.m.):	
Influent	109
Effluent	60
Per cent reduction	45.5
Grit (per cent solids)	49.8
Grit (per cent volatile)	36.9
Raw sludge to digester:	
Per cent total solids	9.1
Per cent volatile solids	61.3
Sludge digestion:	
Gal. added (1,000)	35,968
Dry solids added (tons)	13,894
Loading rate, lb. per cu. ft. per month	7.72
Gal. withdrawn (1,000):	
To filters	28,743
To tanks	7,042
Dry solids withdrawn (tons)	10,277
Gas produced:	
1,000 cu. ft.	131,818
Cu. ft. per lb. vol. sol. added	7.73
Cu. ft. per lb. vol. sol. consumed	20.58
Supernatant:	
Per cent solids	6.8
Per cent volatile	51.1
Sludge filtered:	
Mixed sludge to filters:	
Per cent solids	8.6
Per cent volatile	59.7
Thousand gal.	142,068
Tons dry solids	52,271
CaO used (%)	7.31
$FeCl_3$ used (%)	2.04
Filter yield (lb. per sq. ft. filter area per hr.)	5.9
Sludge cake:	
Total solids (%)	31.2
Volatile solids (%)	56.0
Incineration:	
Wet (tons)	206,396
Dry (tons)	68,194
Volatile (tons)	36,811
Wet feed rate per incinerator (tons per hr.)	7.9
Fuel oil per wet ton burned (gal.)	0.175
Electric power (100 kw.-hr.):	
Purchased	175,760
Generated	11,447
Total used	187,207
Main pumps	141,298
Auxiliary power	45,909
Kw. per m.g. (pumping only)	112
Chlorination:	
Chlorine demand (p.p.m.)	6.7
Chlorine applied:	
tons	2,342
p.p.m.	4.4
Per cent demand satisfied	66.6
Coliform indices (M.P.N. × 1,000):	
Influent	4,984
Effluent	1,013
Per cent removed	79.68
Accident frequency rate (disabling injuries, per million man hours)	17.57
Accident severity rate (days lost per 1,000 man-hrs.)	0.222

[1] Suspended solids corrected for included grit. Rakings ground and returned to raw sewage flow.

1947–48 Annual Report of the San Diego, Calif. Sewage Treatment Plant for the Year Ending June 30, 1948 *

Sewage treated by the San Diego sewage treatment plant during the fiscal year 1947–48 amounted to 8,543 m.g. for an average of 23.342 m.g. per day.

This flow represents an increase of approximately 12 per cent above the previous year and in turn reveals an overload of 64 per cent above the designed capacity of the present plant.

Fertilizer

The handling of fertilizer from the hopper of the storage room is being done more efficiently than in the past. Sacked fertilizer is now conveyed from the sacking room floor directly to storage by a series of conveyors. Gravity rollers were purchased and legs fabricated at the plant. These rollers have eliminated the hazard of back injuries and have reduced the cost of this operation.

Safety and Training

Personnel training and safety and sanitary measures have been carried on throughout the year with regular monthly safety meetings being held at the plant. As in the past, many excellent suggestions made by the operating and maintenance staff at these meetings have been put into effect.

To the period ending June 30, 1948 the employees have worked a total of 1,075 calendar days without a disabling accident. The plant received the City Manager's Safety Award for the third successive year.

"In-service training" has been carried on as in the past.

Where practical, each employee is coached and trained to assume duties one step up in the organization and is given an opportunity to act in such capacity as occasions may warrant. Employees are furnished with material for reading and study and all are encouraged to follow definite courses of study.

Laboratory

An extensive city-wide field investigation is being conducted for the purpose of controlling the corrosion and deterioration of pumping stations, sewer lines, and septic tanks.

Investigations of all complaints concerning odor originating in the sewer system has proven a valuable source of information in eliminating obnoxious conditions at various points throughout the city.

The control of industrial waste entering the sewer system has been continued during the year with good results. Following investigation and recommendation, the largest slaughter and packing house in San Diego has installed a small pretreatment plant which treats that waste satisfactorily. Other analyses are being made to protect the sewage treatment plant from loss of efficiency due to the entrance of toxic wastes into the sewer system.

Screenings

Screenings gathered from the manually cleared bar screen have been ground daily in the Gruendler grinder and returned directly to the incoming raw sewage. This method of disposal has proven satisfactory. Since the installation of the steel bottom grates in the grinder this machine has given no trouble.

Sewage Pumping Stations

In January, 1948 this division took over the operating and maintenance of all sewage pump stations.

Since that time two stations have been rebuilt, air scrubbers, electrode control, and hour meters have been installed. Buildings at three stations have been repainted.

* For last previous extract see THIS JOURNAL, **20**, 1, 123 (Jan. 1948).

TABLE III.—Summary of Operation Data for 1947–48 at San Diego, Calif.

Item	Average
Sewage flow (m.g.d.)	23.34
pH raw sewage	7.3
Suspended solids:	
Raw (p.p.m.)	360
Effluent (p.p.m.)	120
Removal (%)	66.8
Raw sludge:	
pH	6.4
Dry solids (%)	5.1
Volatile solids (%)	80.4
Digested sludge:	
pH	7.2
Dry solids (%)	3.6
Volatile solids (%)	61.4
Reduction volatile solids (%)	61.2
Reduction total solids (%)	49.2
Alkalinity (p.p.m.)	4,000
Elutriation:	
Dig. solids (%)	4.8
Volatile solids (%)	61.0
Alkalinity elutriated sludge (p.p.m.)	1,168
Alkalinity wash water (p.p.m.)	360
Sludge dewatering:	
Wet cake produced (tons per mo.)	373
Dry solids (%)	27.7
Cake yield (lb. per sq. ft. per hour)	1.84
Ferric chloride (% of dry solids)	5.76
Total operating cost ($)	169,140.76
Revenue from sale of fertilizer ($)	18,117.60
Net operating cost ($)	151,023.16
Total operating cost per m.g. ($):	
Labor	7.35
Material and supplies	3.58
Power	1.77
Overhead	1.65
Total	14.35
Net operating cost per m.g. ($)	12.23

Plant Maintenance

In view of the pending plant enlargements, no improvements to the present plant were made during the year with the exception of the installation of stainless steel lining in the fertilizer storage hopper and the installation of the gravity roller system for moving sacked fertilizer. It might be interesting to note that war surplus duro-aluminum has been found to be very satisfactory material to use in some places where steel or wood were not practical.

Sulfide Control in Sewer Mains

Practically every main sewer line in the San Diego area is being investigated for sulfides. The sulfide concentration has been materially reduced and odor complaints have definitely been eliminated in various parts of the city. This program is to continue in an effort to control the corrosion and deterioration of the pumping stations and sewer lines.

Operating data for the year are summarized in Table III.

SEWAGE QUANTITIES AND CHARACTERISTICS AT CRANSTON, R. I.*

By Henry F. Munroe and Walter H. Brown, Jr.

Respectively, Chemical Engineer, Builders-Providence, Inc., Providence, R. I., and Superintendent of Sewage Treatment, Cranston, R. I.

For some years, the Cranston, R. I. sewage treatment plant has encountered difficulties in operating as an activated sludge plant, for which it was designed. These difficulties began when a considerable flow of brewery wastes was admitted to the sewer system.

As a step towards the solution of

* Presented at 1948 Fall Meeting, New England Sewage Works Association, Newport, R. I., September 10, 1948.

this problem, a detailed study was made in February, 1947 of the sewage flow and strength characteristics. This particular month was selected because time was available for a complete B.O.D. survey, although personnel and laboratory facilities were not adequate for a simultaneous and comparable solids survey.

A review of the monthly operating reports shows that the sewage flow in February, 1947 was average in quanity, but below average in B.O.D. Summer B.O.D. averages are about 20 to 25 per cent higher than those shown. Routine control tests for the month of study show that the total solids averaged 863 p.p.m., 55 to 60 per cent of which were dissolved. On Sundays the total solids averaged 300 p.p.m., about 65 per cent being dissolved.

Metering Facilities

The Cranston plant is modern in every respect, and is equipped with all necessary apparatus for scientific operation. The unusually complete metering facilities (1, 2, 3, 4) were of great value in this study.

Figure 1 pictures the registers for the Venturi meters used for measuring raw and settled sewage; primary, return, activated, and excess activated sludge; and air. Also included are Flow Ratio Meter registers (Figure 2) which give the rates and ratios of air and settled sewage, and of return activated sludge and settled sewage.

The raw sludge meter installation has been described in detail by Richardson (5). The totalizer-recorder is operated from the Venturi tube with air relay units, and the Venturi tube

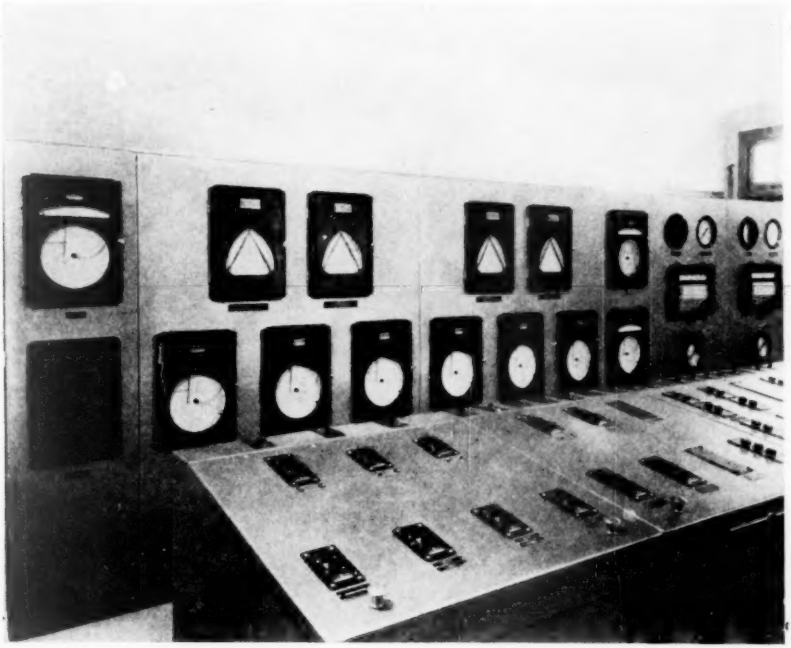


FIGURE 1.—Control desk and meter panel at Cranston, R. I., sewage treatment plant.

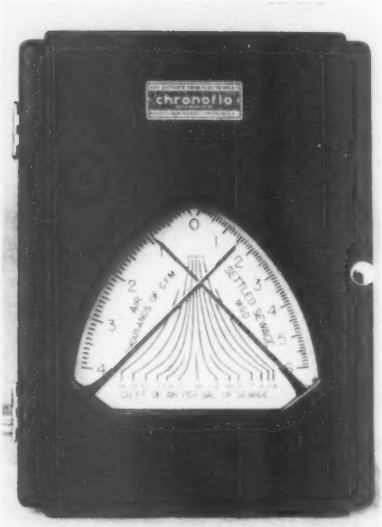


FIGURE 2.—Flow ratio meter register which indicates rates and ratios of air and settled sewage.

is equipped with a continuous flush-check system (Figure 3). This consists of the injection of a small stream of clear water into each piezometer connection, which prevents sludge flow into the piping of the instrument. Over a test period of 3 months this installation has checked within 1.5 per cent of digester measurements.

At the extreme right-hand panels in Figure 1 are mounted indicating instruments for digester temperature, hot water flow pressure, and digester gas pressure, as well as indicating-recording temperature gauges for sludge and hot water to and from the digester heating coils.

Sewage Flow

A breakdown of the daily total flow for February shows that the peak flow is on Friday, with Monday the next highest, then Tuesday, Thursday and Wednesday. Saturday's total flow, as well as the B.O.D. content, shows it to be a transition from the high trade waste content of the weekday to the purely domestic content of the Sunday sewage.

Figure 4 shows a typical daily flow chart for the month of February, 1947. The flat-toothed characteristic of this chart is due to the pumping schedule the plant being fed by a main lift station with float-controlled variable speed pumps. It should be noted that the flow represented here is far below the design average flow. This is due to the fact that although the construction of the system is 70 per cent complete, there are less than 40 per cent of the anticipated connections, with approximately 27 per cent of the design flow.

The upper left-hand chart in Figure 5 gives the calculated hourly average flows for the month of February, 1947. These data were obtained by planimetering all charts for the month of February; the hourly average was determined by planimetering that area between the hourly time lines and plotting the average result for each of the 24 hours. By this method four values have been included in the average for each hour of each week day, or 28 separate values for each hourly average.

It will be noted in this chart that the flow unit has been changed to "tens of thousands of gallons." Since each plotted amount is for an hour interval, this result is comparable to a rate of flow of tens of thousands of gallons per hour.

Three averages have been plotted: (1) the 7-day average, as shown by the full line; (2) the 5-day average, as shown by the dotted line; and (3) the Sunday average, as shown by the broken line. It will be observed that there is not a great deviation between the Sunday average and the 7-day average. The Sunday flow is 70 per cent of the Friday or maximum daily flow.

Sperry (6) reports a Sunday flow deviating from 87 to 113 per cent of

average. These data show a Sunday average flow deviation of 60 to 138 per cent of average. Sperry comments, "The sewage collected is generally domestic in character." Cranston Sunday flow is also generally domestic in character.

A comparison with Camp's graph of hourly variations of sewage flow (7) gives a flatter curve with a more pronounced "dip" from 12 midnight to 8 A.M. Camp points out that this theoretical curve "will vary from day to day and will be different for different services and different localities." Camp's curve shows a flow variation of 45 to 170 per cent of average, whereas the Cranston daily flow varies from 58 to 138 per cent of average. A comparison of the 7-day average curve with the average hourly variation curve for an average of seven cities, as given in Babbitt's "Sewerage and Sewage Treatment," shows close agreement. The Cranston 7-day curve is 10 per cent lower at the 8 A.M. to 12 noon period, and 15 to 20 per cent higher in the 2 to 10 P.M. period.

It is interesting to note that this chart gives the hour of minimum flow as 6 to 7 A.M. Since there is a 2-hour lag in the Cranston system at this time, the actual hour of minimum flow would be 4 to 5 A.M.

From the preceding charts it will be apparent that the introduction of the brewery waste into the Cranston

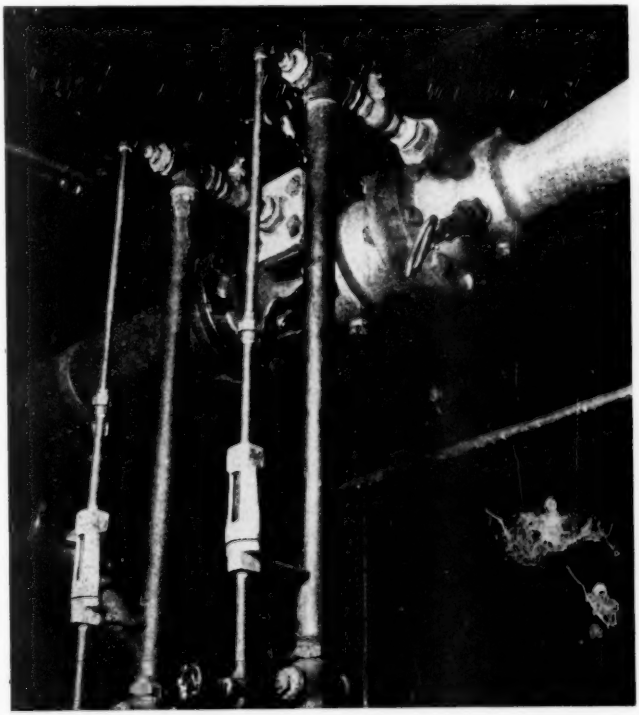


FIGURE 3.—Continuous "Flush-Check" water injection system in service on primary sludge meter at Cranston, R. I.

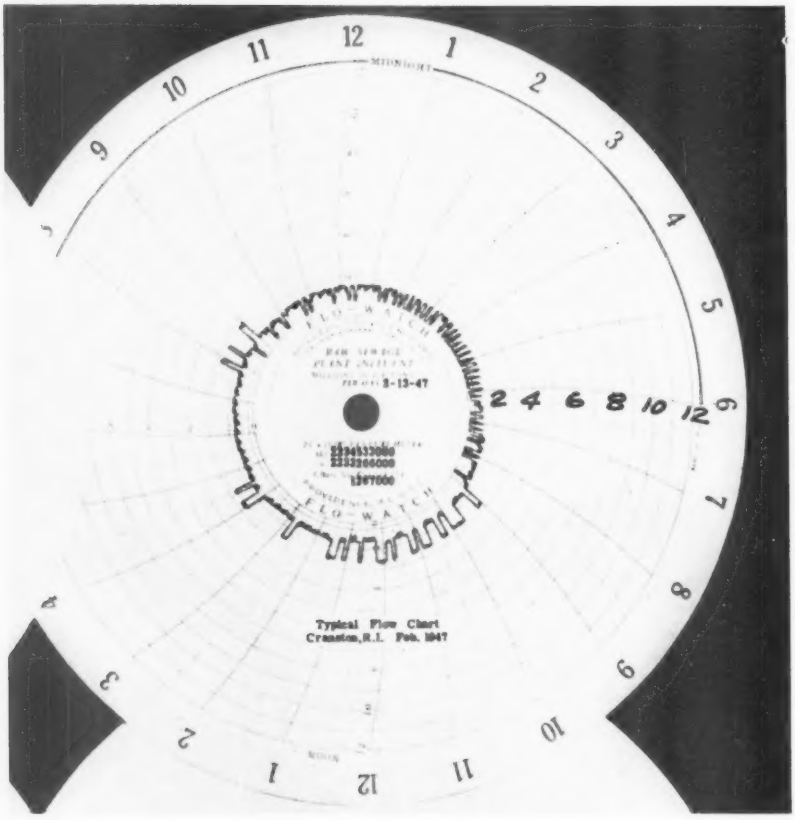


FIGURE 4.—Typical daily flow chart, Cranston, R. I.

system has had a leveling effect on flow variation. However, the fact that the average total flow is only 27 per cent of the design average increases the detention periods and interferes with the treatment processes, particularly when tests show that the raw sewage has an immediate oxygen demand of 6 to 8 p.p.m.

B.O.D. Studies

As was previously stated, these data were obtained when personnel and equipment were available for B.O.D. determinations alone. One familiar with laboratory procedure can appreciate the size of this project in arranging for B.O.D. bottles, available incubator space, etc. All of these tests were run for the full 5 days at 20° C., using bicarbonate dilution water, and were made in accordance with the procedures outlined in "Standard Methods."

The lower left-hand chart in Figure 5 shows the B.O.D. curves for the month of February, 1947. Again, each plotted point is the average of at least four samples for each hour of each week day. Each sample was taken on the half-hour, or at least as near that

time as possible to avoid the cesspool pumpings sometimes included in the flow and also to avoid sampling during "no-flow" periods.

The average 5-day B.O.D. varies between 150 and 1,550 p.p.m. The Sunday B.O.D. (domestic sewage) varies between 90 and 350 p.p.m. The first mentioned varies widely from Sperry's reported extremes of 40 and 440 p.p.m. This extremely high B.O.D. is due to the local brewery waste, which was admitted to the system without the approval of the engineer. Routine tests have shown that approximately 60 per cent of this B.O.D. is due to dissolved material.

The 7-day average B.O.D. varies from 26 to 217 per cent of its mean value of 578 p.p.m.; the 5-day average B.O.D. varies from 23 to 219 per cent of the mean value of 693 p.p.m.; and the Sunday B.O.D. varies from 31 to 188 per cent of the mean value of 225 p.p.m. Weekly extremes are 90 and 2,200 p.p.m.

B.O.D. Loading

The lower right-hand chart in Figure 5 represents the product of flow

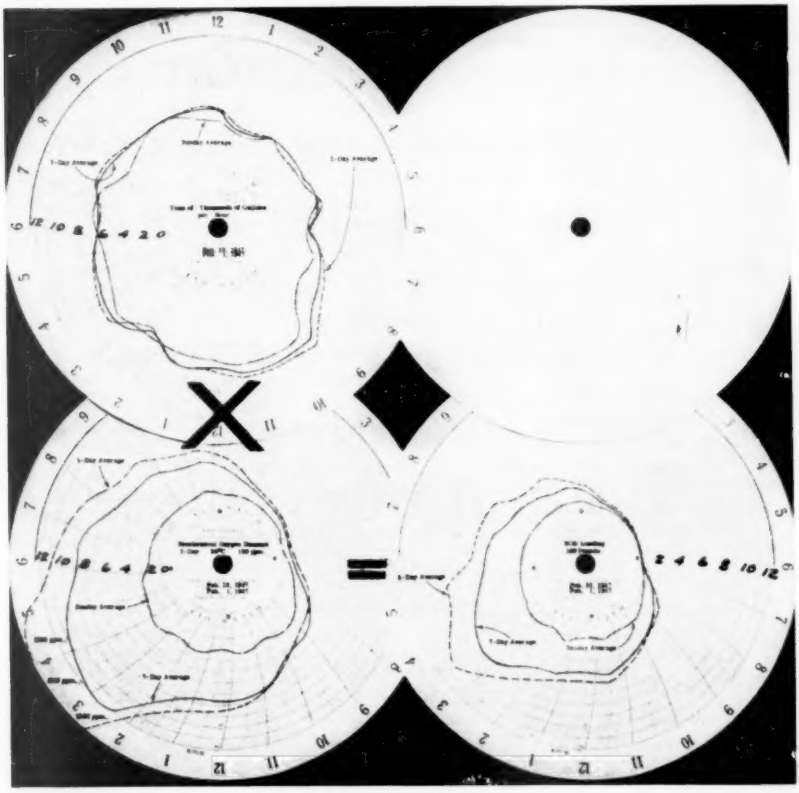


FIGURE 5.—Charts showing calculated hourly average raw sewage flows (upper left), B.O.D.'s (lower left), and B.O.D. loading (lower right) for February 1948 at Cranston, R. I.

TABLE I.—Summary of February, 1947 Operation Data for Cranston, R. I. Sewage Treatment Plant

Hour	Average Hourly Flow (gal.)			B.O.D.—5 Day 20° C. (p.p.m.)							Average B.O.D. (p.p.m.)		B.O.D. Loading (lb.)		
	7-day	5-day	Sunday	M	T	W	Th.	F	Sa.	Su.	7-day	5-day	7-day	5-day	1-day
12–1 A.M.	55,835	57,861	47,840	400	450	450	500	600	210	150	394	480	183	232	63
1–2	40,839	42,331	37,100	200	350	450	300	400	180	150	290	340	99	120	47
2–3	46,340	46,299	46,100	150	200	300	200	400	150	140	220	250	85	97	54
3–4	45,083	44,481	38,812	150	200	150	200	400	140	130	195	220	73	82	45
4–5	42,420	42,526	38,850	150	200	200	150	250	120	130	172	190	61	67	46
5–6	46,000	46,461	50,260	100	150	150	150	250	120	90	144	160	55	62	34
6–7	35,873	36,338	33,687	100	150	150	200	400	120	140	180	200	54	61	40
7–8	50,570	53,674	42,960	150	200	250	400	400	420	200	288	280	121	125	71
8–9	59,182	64,916	39,766	350	350	400	600	400	800	300	457	420	227	208	112
9–10	83,340	90,606	58,925	500	450	400	500	600	800	350	514	490	357	360	190
10–11	85,053	88,705	76,650	550	500	610	1,000	600	800	300	621	650	440	482	190
11–12 Noon	85,800	89,743	74,560	650	900	900	1,000	600	900	350	757	810	542	607	222
12–1	79,900	80,929	71,800	700	850	900	1,200	700	700	300	764	870	508	587	194
1–2 P.M.	80,780	79,508	70,900	720	940	950	1,000	1,200	700	350	837	962	563	639	245
2–3	64,184	61,773	69,700	800	1,200	1,650	1,900	2,200	400	300	1,207	1,550	645	800	176
3–4	79,246	82,510	73,850	600	1,350	1,700	2,000	1,900	200	350	1,157	1,510	763	1,047	209
4–5	73,363	77,231	63,600	650	1,350	1,400	1,800	1,700	300	310	1,073	1,380	657	891	165
5–6	67,495	69,494	59,275	800	1,200	1,200	1,500	1,200	300	280	925	1,180	520	818	142
6–7	62,399	60,964	67,350	750	1,200	1,200	1,300	1,200	200	200	865	1,130	450	574	110
7–8	69,144	70,640	63,425	700	1,000	1,000	1,000	900	150	200	707	920	407	542	110
8–9	63,609	67,255	47,510	500	500	700	1,100	900	200	180	583	740	309	416	82
9–10	58,705	59,576	54,450	500	450	1,000	800	900	150	160	566	730	277	363	75
10–11	58,484	58,148	57,900	420	500	600	700	800	200	160	483	604	235	393	75
11–12 Md. Nt.	59,149	61,798	52,350	420	500	450	700	800	210	190	465	574	229	296	83
Average	62,200	63,906	55,734	458	630	715	841	821	353	225	578	693	327	415	116
Min. (% ave.)	57.7	66	60.5	21.8	23.7	21	17.8	30.5	34	30.7	25.8	22.7	233	252	211
Max. (% ave.)	138	142	138	175	213	235	238	259	255	188	217	219	16.5	14.7	17.5

and B.O.D., or the B.O.D. loading in pounds. These results have been plotted in units of 100 lb. B.O.D. The difference between the day and night loading is here illustrated and accentuated. The Sunday loading curve and the 5-day loading curve show the extremes to which the plant is subjected.

Numerically, there is a change from 16.6 to 233 per cent of the 7-day average of 327 lb. per hour; a 5-day average variation of 14.7 to 252 per cent of the average 415 lb. per hour; and a Sunday range from 17.5 to 211 per cent of the average 116 lb. per hour. During an average 7-day period, the above represents an extreme change in loading from 54 to 763 lb. per hour, or 1 to 14. The data used in plotting the three charts of Figure 5 are given in Table I.

Discussion

It is apparent from the above, that in order to operate as an activated sludge plant some means must be applied to relieve the plant of these extremely wide variations in B.O.D. and solids loading. Fales (8) lists a number of objectionable characteristics of trade wastes which require that they be pretreated or eliminated entirely from the sewer system. The Cranston brewery waste has three of the six objectionable characteristics to which Fales makes reference, namely: "wastes excessively high in suspended solids or subject to precipitation of excessive amounts of solids; wastes containing coarse or heavy solids; wastes excessively high in dissolved and colloidal matter."

Pretreatment of the brewery wastes is now under investigation. It is interesting to note that the brewery management, who had previously been apathetic about the problem, became quite concerned when informed of the cost to them if pretreatment was not provided. Special consideration is now being given to the recovery and subsequent utilization of the yeast and grain.

References

1. "Up to the Minute Cranston, R. I. Sewage Disposal Plant and Sewerage System." *Public Works*, May, 1943, p. 20.
2. Horne, Ralph W., "A Complete Sewage Treatment Works at Cranston, Rhode Island." *Sewage Works Engineering*, June, 1943, p. 290.
3. Horne, Ralph W., "Compact Sewage Treatment Works Units at Cranston, Rhode Island." *Civil Engineering*, **13**, 9 (1943).
4. Horne, Ralph W., "Cranston, Rhode Island Builds Complete New Sewerage Works for 53,000 People." *Journal of the Boston Society of Civil Engineers*, **30**, 2, 66 (1943).
5. Richardson, Charles G., "A New Development in Sludge Metering." *Water Works and Sewerage*, **92**, 198, 6 (June 1945).
6. Sperry, Walter A., "Hourly Variations of Sewage Concentration and Flow." THIS JOURNAL, **19**, 5, 785 (1947).
7. Camp, Thomas R., "Design of Sewers to Facilitate Flow." THIS JOURNAL, **20**, 1, 3 (1946).
8. Fales, A. L., "The Effects of Industrial Wastes on Sewage Treatment." THIS JOURNAL, **9**, 6, 970 (1937).

TIPS AND QUIPS

Sludge for Shoulders

An interesting item on sewage sludge disposal was brought out during the Operator's Roundtable Discussion at the North Carolina Sewage Works Assn. meeting last November.

The State Highway Department is very anxious to obtain as much dried sludge as the North Carolina plants can furnish because of the excellent results obtained from the use of sludge on road shoulders. Sewage sludge has assisted materially in the development of thick, sturdy stands of grasses on these areas, which are usually devoid of top soil and on which the use of commercial fertilizers cannot be justified.

This outlet for sewage sludge offers great possibilities since state and county highway maintenance crews are located in nearly every town having a sewage disposal works. Furthermore, maintenance trucks of necessity make many trips over their territories without payloads, and on many of these trips sludge could be hauled and spread without extra cost.

Local conditions may call for different selling methods, but the idea has great possibilities for operators willing to use a little imagination and persistence.

Filter Flies and DDT

More than one sewage works operator can testify that effective control of filter flies with DDT involves more than mixing up a batch of the concentrate and throwing it in the dosing tank. Two recent reports of sewage works operators who tried the use of DDT clearly indicate that every plant constitutes a different problem and considerable experimenting may be necessary to determine the most effective dosage rate and method of application.

At the Rochester, N. Y. Sewer District No. 2 plant, George H. Bush found it necessary to try several methods of DDT application to the filters. The method finally adopted was to cut off the flow to the dosing tanks just after the siphon operation started. When the dosing tank was nearly empty the DDT solution was poured directly into the distributor arm and the arm allowed to make one complete revolution. The filter was then rested for 6 hours. Good results were obtained in controlling the filter flies even though the dosage rate of 1 lb. per acre-ft. of filter media was considerably below the rate used by Lt. Brothers in his experimental work at Camp Fannin, Texas (see THIS JOURNAL, **18**, 2, 181 (March 1946)).

William McMullin, superintendent of sewage treatment at Collinsville, Ill., also experimented considerably before finding a successful DDT dosage rate and application method for the Collinsville filters. Best results were obtained by applying the 30 per cent DDT emulsion to the dosing tank, and resting the filter immediately following the application. Effective control was obtained with a dosage rate of 5.5 lb. DDT per acre foot. Each treatment appeared to control the flies for about 3 weeks.

McMullin is of the opinion that the controlling factor in determining the optimum dosage rate is the volume of the filter media rather than the rate or volume of sewage flow. The Corner welcomes other operators' comments concerning methods of DDT application and optimum dosage rates for filter fly control.

Opportunity for Operators

Every sewage works operator has an opportunity to achieve national recognition in his field by entering the competition for the Hatfield Awards, the Federation's awards for excellence in

the preparation of annual operation reports.

Competition for most awards of necessity is drawn from a rather limited group. Not every plant has operating characteristics which a plant superintendent may use to develop a significant contribution to the operation art, and thus become eligible for the Gascoigne Award. Likewise, research opportunities are not universally available. Other Federation awards can be won only by men of exceptional experience and outstanding ability, characteristics which require years for development and recognition. But the Hatfield Awards may be won by any wastes treatment operator, municipal or industrial, who sets himself to the task of producing an attractive and complete annual plant operation report.

Plant size has been eliminated as a factor in the competition by the establishment of three Hatfield Awards, each of equal value. An award will go to the operator in each of the three following groups who submits the best annual report on plant operation: Plants serving less than 10,000 population or population equivalent, plants serving 10,000 to 100,000, and plants serving more than 100,000. Notice that phrase "population or population equivalent." It makes industrial waste treatment plant operators equally eligible with sewage plant operators for the awards.

To enter an annual report for a Hatfield Award requires only the submission of five copies of the report to the Federation Secretary before June 1st. Reports must be printed, mimeographed, or typewritten and must cover a 12-month operation period beginning with some month within the 24 months immediately preceding July 1st of the year the award is granted. Thus, for the 1949 awards, allowing 1 month to prepare and submit the report, an eligible report could cover any 12-month period between July 1, 1947 and May 1, 1949.

All reports submitted will be examined and graded by the Operation Reports Committee of the Federation. The items on which reports will be rated and scored are:

Item	Maximum Percentage Points
1. If report is printed or duplicated by mimeograph, etc.	5
2. General format of report—appearance, attractiveness, binding, use of illustrations such as cl arts or photographs.	10
3. Contents or text of report, covering the following items:	
a. Introduction giving purpose and some historical background of plant.	5
b. Description of treatment works.	10
c. Pertinent data concerning design and actual loadings of plant	10
d. First cost and operation cost data.	10
e. Plant performance data based upon analytical and other records.	15
f. Evaluation of operating data.	5
g. Effects of effluent on receiving waters.	5
h. Statement of operating problems.	5
i. Statement re: research, training activities or public relation matters.	5
j. Maintenance program.	5
k. Conclusions or recommendations.	10
Total.	100

Each Committee member will rate each report and the average score will be used for the report. In each population group the report having the highest average rating will be adjudged the winning report.

Enter your 1948 Annual Report in the Hatfield Award competition as soon as you complete it. Take advantage of the unusual opportunity the Federation provides for achieving national recognition in your chosen work.

Combating Corrosion

An improved type of corrosion inhibator zinc rod has recently been developed which is fitted with standard pipe-plug ends. The new rods are easily screwed into heat exchangers, hot water tanks, boiler jackets, piping, and other hydraulic equipment to protect against corrosion. They are available in diameters of $\frac{3}{8}$ to 1 in., with lengths up to 12 inches.

Termed COR–INS (Figure 1), these improved rods extend the protection of galvanizing but can be renewed readily merely by unscrewing the used-up zinc rod and screwing in a new one. Equipment may thus be protected indefinitely.

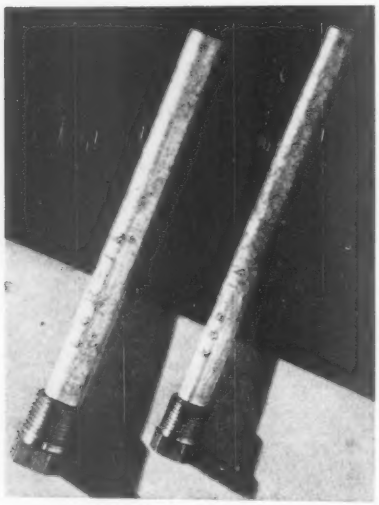


FIGURE 1.—Corrosion inhibitor zinc rod.

The zinc rod used in COR–INS has a higher electro-chemical potential than the metals to be protected from corrosion. Thus oxygen or other corrosive agents consume the zinc in preference to the electro-chemically less active metals of which pipes, tanks, etc. are usually made.

Many metals used as substitutes for zinc are more reactive than zinc but generally these must depend upon film formation to slow down their violent reactivity with water. The zinc rod used in COR–INS is tested for its ideal reactivity ratio in water to insure that it will become more active when corrosive influences are severe while remaining more passive when such conditions are mild.

Many sewage plants will find ready use for this type of corrosion control for digester heating coils, boilers, heat exchangers, and gas engine cooling systems if these rods prove to be all that is claimed for them.

Death in Iowa

For the third time in 13 months, tragedy has visited an Iowa sewage treatment plant.

October 16, 1947—Robert J. Lamphear, Carter Lake sewage works operator, died as the result of a fall into the treatment plant raw sewage wet well. He was overcome by gas while descending a ladder to repair the sewage pumps. A helper narrowly escaped death when he attempted to rescue Lamphear.

October 18, 1948—Hans C. Hansen, operator of the Clarion sewage treatment plant, was severely burned in an explosion and fire in the service building. Hansen suffered third degree burns over an estimated 40 per cent of the skin area of his body. The fire was caused by the explosion of gasoline with which Mr. Hansen was cleaning jars inside the service building. The flash-back undoubtedly resulted from the open flame at the digester heating boiler. At the last report, Mr. Hansen was still alive, but a nurse's aid at the hospital related "that the poor man lies there praying and hoping that the good Lord will take him."

November 18, 1948—David Klickner, employee of the Ft. Dodge sewage treatment plant, was found dead in a waste gas meter pit. The coroner re-

ported that death was due to gas poisoning. Klickner, who apparently had been checking a valve in the pit, had been dead about 3 hours when found.

Dead men have indeed died in vain if live men will not profit from their mistakes!

Illinois Sewage Works Operators Honored

Three Illinois sewage works operators won deserving honors when C. W. Klassen, Technical Secretary, Illinois Sanitary Water Board, presented the Memorial Award Trophies at the 1948 meeting of the Illinois Sewage Works Operators' Conference.

Walter A. Sperry, superintendent, Aurora (Ill.) Sanitary District, was awarded the Fred S. Simms Trophy for the best monthly operation reports. The Everett E. Smith Award for outstanding plant operation went to Lafe Dixon, superintendent, Arthur (Ill.) sewage treatment works. For the best job of plant maintenance during the year, Reinhold Spiess, superintendent, Litchfield (Ill.) sewage treatment plant, received the Harry E. Wilson Trophy.

These memorial award trophies are of burnished bronze and stand about 30 in. high. They memorialize the lives of three men who were outstanding sewage works operators in Illinois. The trophies will be awarded annually, with the winning operators retaining possession of the trophies for the following year. Selections are made on the basis of what an operator accomplishes with the facilities available. That the larger plant operators will have no monopoly in winning these trophies is indicated by the size of the towns of the 1948 winners—48,000, 1,400, and 7,100 persons, respectively.

Outstanding sewage works operators deserve recognition—particularly by their fellow operators.

An Easy Way to Do a Hard Job

Every operator knows from experience the time and effort required in fastening pipe hangers, switch boxes, and similar equipment to concrete or metal supports. It nearly always involves star drilling, inserting toggle or anchor bolts, and other time-consuming efforts.

A recently developed remedy for this problem is an amazing powder-actuated driver (Figure 2) that will "pin" a pipe hanger or similar fastner to a concrete ceiling or wall, steel I-beam or column, in a few seconds. It will also fasten wood, such as joists or nailing strips, to concrete or metal.

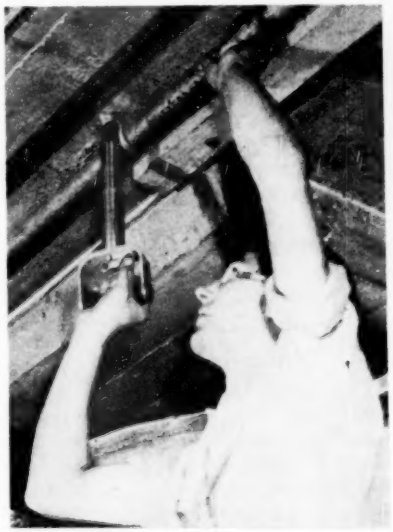


FIGURE 2.—Powder-actuated hand tool for fastening studs to concrete or steel.

This small, portable tool, manufactured by a leading maker of safety appliances, embeds studs in steel or masonary by the discharge of a blank cartridge. Once embedded, the studs have tremendous holding power, up to several thousand pounds.

Two diameters of studs—3/8 in. and

¼ in.—may be used by interchanging the barrels of the tool. There are several varieties of studs available, with externally or internally threaded or plain-headed types.

Operation of this 5-lb. tool is simple. The stud, with the cartridge attached to it, is inserted in the barrel. The spring-loaded safety arm is rotated 180 degrees to move the firing pin into position. Holding the barrel against the material to be penetrated, the tool is pushed forward sharply to discharge the stud.

The manufacturer asserts that every precaution to minimize hazards is "built-in" the tool. Possibility of accidental discharge is negligible, and if the tool is dropped accidentally the safety arm instantly moves the firing pin out of position. It is virtually impossible for the stud to richochet because the stud remains fastened to the cartridge with a piston-like attachment until the instant of penetration. There is no recoil or flash. The tool can be operated with one hand.

In the interests of safety, plant superintendents are cautioned to resist any urge to use this tool on slow-moving employees—or municipal officials!

Light for the Darkness!

Paul Krebs, engineer of Polglaze & Basenberg, threw considerable light on a normally dark subject during his discussion on "Construction, Inspection, and Maintenance of Sanitary Sewers" at the 1948 meeting of the Alabama Water and Sewage Works Association. The following are his excellent suggestions on the "lamping" of sewers, as reported in the *Official Bulletin* of the Alabama Association:

"The ordinary flashlight is a feeble source of light for lamping a sewer. A strong beam is necessary to carry through a section between manholes. Mirrors are very satisfactory, except when the inspection happens to fall on a cloudy day. The best picture of the section being inspected can be secured by looking into the light held at the next manhole. An effect similar to looking down a rifle barrel is obtained if the sewer is in good alignment and on a uniform grade. If the whole of the diameter is not visible, the beam can be directed ahead, picking out and counting each joint so that when the offender is reached an approximate location for digging may be given.

"To get into position for lamping the larger sewers is no great problem, but the only way that the writer has found to look through the smaller pipes is as follows: Kneel on the manhole benches, straddling the invert and facing in the opposite direction from the section to be inspected. Then lower the head to the invert of the sewer and look through the legs back into the pipe. The method is not recommended for lamping sewers already in service."

Mr. Krebs concluded his talk with the following remarks, which we wish could be framed and hung on the wall of every sewage works operator's office!

"When one has solved a tough problem and feels like commending himself for doing so, he might stop and consider—without detracting from his accomplishment—the fact that there are many sewerage systems; that these systems have been in operation many years; that problems similar to his must surely have arisen; and that some other good sewage works man solved the problem, possibly in exactly the same manner that he did. Unfortunately, few people were interested in how the thing was done, but rather in how soon it was done. As a result, the first sewage works man never compiled a record of his problems and solutions; and those thereafter did not have the benefit of this experience."

Why not take advantage of The Corner as a place for recording the solutions of your sewage works problems, and thus make available to other operators the results of your labors?

What Is It?

No, Figure 3 isn't a printer's mistake! It's a sludge-eye view of a new nylon filter cloth recently introduced

for rotary vacuum or pressure filters.

Reportedly resistant to acids, alkalies, and bacterial action, as well as abrasion and mechanical abuse, the new cloth may contribute considerably to increased efficiency and reduced maintenance of vacuum sludge filters.

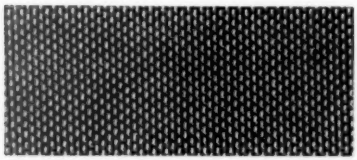


FIGURE 3.

If these new nylon filter cloths do not develop a tendency for the thread to split into individual strands which obstruct the openings between the threads, as several types of plastic cloths have done, they may prove to be a significant improvement to the sludge filtration process.

First, nylon brushes for fine screens; now nylon filter cloths. Some day a sewage works operator may as casually refer to "my nylons" as his wife does now!

Temptation!

With all the usual cares and woes of a sewage treatment works on his shoulders, Earnest Massey, sewage works operator of Hartford City, Ind., has what must almost be the last straw —glass-covered sludge drying beds located directly below a railroad embankment! If there is the usual quota of boys in Hartford City worthy of the name, Massey by now must be quite proficient with the putty knife.

Wonder what the sludge drying cost runs in panes of glass per cubic yard of sludge?

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GLOSSARY—WATER AND SEWAGE CONTROL ENGINEERING

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Only a limited edition is planned. To avoid disappointment send in your advance order now. Distribution of the Glossary is anticipated about the middle of April.

Federation of Sewage Works Associations

325 Illinois Building **Champaign, Illinois**

Editorial

THE FIRST STEP IN WATER-BORNE RADIATION CONTROL

In their paper presented at the 1948 Annual Meeting of the Federation (THIS JOURNAL; January, 1949; page 63), Arthur E. Gorman and Abel Wolman have given an excellent outline of the new responsibilities confronting the sanitary engineering profession as a result of nuclear fission operations. This paper, with the discussion by L. R. Setter, is worthy of more than casual reading.

The Atomic Energy Commission is frank in its admission that problems exist in connection with the disposal of radioactive wastes. In a move to acquaint sanitary engineers with the nature of these problems, the Commission held a seminar on "Disposal of Radioactive Wastes" in Washington, D. C., on January 24–25, to which 30 sewage works, water works and public health engineers were invited. The seminar was opened by AEC Chairman David E. Lilienthal, whose remarks are repeated here as evidence of the Commission's attitude toward its responsibilities:

"The Atomic Energy Commission is the proprietor, as trustee for the people of the United States, and the operator of a very large industry, a new industry, and one that is unique. It is one of the very largest integrated industries in the world and it is certainly the newest. In the course of the operation of this industry for the production of materials that will sustain the chain reactions—plutonium and uranium 235—some very important waste materials arise. They are new in kind but they are not unique in the sense that every new industry and all existing industries have problems of a comparable or analogous character.

"Some industrial wastes have been handled well at the outset but in many industries the problems associated with waste disposal have not been handled well at the outset. It is our earnest desire and our responsibility to seek to have this phase of our operations well handled—as well as technical skill and energy and foresight at this stage can handle it.

"For my part, I think the viewpoint with which problems of this kind, and others even more difficult, need to be discussed with the American people is this: We have to learn to live with radiation.

"This has become a kind of 'fourth R.' We know something about radiation and a great many people have actually lived with it. There are men in the X-ray field who are entirely familiar with radiation, who work and live with it every day. But now, the magnitude of this problem of living with radiation has changed in such an order that it is almost a different kind of problem. Whereas people are familiar with an X-ray machine or 5 grams of radium and have learned how to handle them, within the pile at Oak Ridge there are radioactive substances the equivalent not of the total radium supply of the United States—which is in the order of 30 ounces—but of tons of radium.

"The waste disposal problem is a part of this general business of learning how to live with radiation. The way we have learned to live with things before was to learn as much as we could about them; to keep our shirts on; not to get overly emotional or hysterical; not to escape from things by emotional outbursts. . . .

"Radiation is just as much a natural phenomenon as anything else. The fact that we have multiplied it by intelligence does not change that fact. I am sure there will be a good deal of shock, at first, as we get used to these facts. But I am sure also that just as we were able by our intelligence to conquer other things, we will conquer this as well. I am confident

that by the application of such professional talents as you represent here and various other experts—the medical officers, the sanitary engineers, the water works engineers, the biologists, and so on—something very solid and sensible will develop."

By its sponsorship of the waste disposal seminar, the Atomic Energy Commission has shown its willingness to establish a closer relationship than in the past with public health and safety authorities on mutual problems arising from the atomic energy program. Security limitations, of course, will limit the intimacy of such relationship. The Federation has joined with other national sanitary engineering organizations in offering their facilities for the dissemination of all information and data that can be released to the professional field. There is also a possibility that a special Sanitary Engineering Advisory Committee may be created to cooperate with the AEC, which move has much to commend it.

It was obvious to those who attended the AEC seminar that technologists engaged in water quality control must now add a fundamental knowledge of nuclear physics to their present background in engineering, chemistry and biology. Radioactive substances cannot be detected or measured by methods now employed in cases of chemical or bacterial pollution, and the public health aspects of high energy radiation are likewise greatly different from those of present-day significance. We must prepare ourselves to use and interpret new instruments, parameters, techniques, units and tolerances, all deriving from a relatively new science. This elementary foundation must be laid before we can attempt any intelligent approach toward the treatment, disposal or control of waters containing radioactive substances.

The burden of self-education is upon all of us as individuals. The references listed with the Gorman-Wolman paper and Setter discussion, as cited above, are particularly recommended as a beginning. Any good library will contain additional material for advanced study. A special bibliography on radioactive wastes is now being compiled by the AEC, and is expected to be made available soon.

Acute problems of water-borne radiation may be with us sooner than we may anticipate. It is by no means too early for us to prepare for them.

W. H. W.

Proceedings of Member Associations

CENTRAL STATES SEWAGE WORKS ASSOCIATION

Twenty-First Annual Convention

Milwaukee, Wisconsin, June 18–19, 1948

The Central States Sewage Works Association held its 21st Annual Convention at the Schroeder Hotel, Milwaukee, Wis. on June 18 and 19, 1948. A total of 211 members registered. The first session, with President H. G. Rogers presiding, opened with an address of welcome by Mayor Frank Zeidler of Milwaukee. In his comments Mayor Zeidler pointed out that sewage treatment plant operators and engineers must be more than technical experts and that they must become more vocal in order to get their municipalities to spend more money on sewage disposal and other needed improvements. He stressed the fact that too much money is being spent these days on non-essentials, requiring that essential improvements be postponed indefinitely.

The first technical paper on the program, presented by Walter M. Kunsch, was entitled "Sludge Digestion Experience with External Heat Exchanger." The next paper, "Chemical Conditioning of Undigested Sewage Sludge," was presented by Professor H. O. Halvorson.

The afternoon technical program included papers on "Developments in Sewage Chlorination" by Fred B. Strandskov, Henry C. Marks, and Don H. Horchler; and "Packing House Waste Treatment by the Activated Sludge Process," by C. A. Stravinski, W. L. Lea, and G. A. Rohlich. The remainder of the afternoon was devoted to a panel discussion on milk waste with T. F. Wisniewski, presiding. The discussion leaders were Don E. Bloodgood, Frank J. McKee, A. J. Steffen, and R. W. Heider.

The program for the annual banquet included a talk by George S. Russell, President of the Federation of Sewage Works Associations, and presentation of Federation Awards to Central States members. The principal speaker was Dr. H. B. Hass of the Chemistry Department of Purdue University, who spoke on the subject "What's New in Chemistry."

The Saturday morning program was devoted to the Operator's Breakfast forum. This was followed by the annual business luncheon. Following committee reports, officers were elected for the year 1948–49.

President: Carl B. Carpenter, Hammond, Ind.
First Vice-President: L. S. Kraus, Peoria, Ill.
Second Vice-President: H. T. Rudgal, Kenosha, Wis.
Third Vice-President: M. L. Robins, Minneapolis-St. Paul, Minn.
Secretary-Treasurer: Paul W. Reed, Indianapolis, Ind.
FSWA Director: George W. Martin, Green Bay, Wis.

The meeting was concluded by an inspection trip to the Milwaukee sewage treatment works.

PAUL REED,
Secretary-Treasurer

VIRGINIA INDUSTRIAL WASTES AND SEWAGE WORKS ASSOCIATION

Second Annual Meeting

Alexandria, Virginia, October 7–8, 1948

The Second Annual Meeting of the Virginia Industrial Wastes and Sewage Works Assn. was held October 7–8, 1948 at Alexandria's Hotel George Mason. The meeting opened at 11:00 A.M. Thursday, President Reid W. Digges presiding. After a few words of welcome from the Honorable W. T. Wilkins, Mayor of Alexandria, and a short business session, the group adjourned for a get-acquainted luncheon.

First paper to be presented at the Thursday afternoon technical session was "Sewage Treatment for Housing Developments, Institutions, and Camps," by R. W. Simpson, Sanitary Engineer, Gilbert Associates, Inc., Reading, Pa. Mr. Simpson discussed design criteria for various types of "pint-size" sewage treatment plants and presented practical information on their operation and maintenance.

A discussion of Mr. Simpson's paper, prepared by Harry Shaw, Chief Engineer, Washington Suburban Sanitary Commission, was read by R. G. McLeod, Assistant Chief Engineer. He presented further design, operation, and maintenance information, as well as data on the applicability of certain types of plants to specific treatment requirements.

Of timely interest to municipal and stream pollution control officials was a paper by Capt. W. C. Hiltabidle, assistant chief of the Navy's Bureau of Yards and Docks, on "Separating Storm and Sanitary Sewage at Navy Bases."

"Planning for Sewage Treatment in the Northern Virginia Metropolitan Area," a paper by Edwin R. Cotton, engineer-secretary of the Interstate Commission on the Potomac River Basin, reviewed the general pollution problem existing in the basin and outlined steps being taken by the Northern Virginia Planning Commission's Committee on Sewage Disposal toward making a comprehensive study to determine the sewage treatment scheme or schemes which would best serve the several jurisdictions concerned. In the discussions following this paper, James J. Corbalis, sanitary engineer for Fairfax County, gave additional information on this area's pollution problems and plans for sewage treatment.

Illustrated with slides of equipment now in use and with operating data on actual installations, "Sewage Sludge Gas Engines," by Jack Goldthorpe of Worthington Pump and Machinery Corporation, Washington, proved to be an informative paper. Stressing particularly economies of sewage treatment plant operation which sludge gas engines are capable of effecting, the paper was appropriate in these times of high construction costs, when many sewage treatment plants are being planned but few are actually being built.

Frank E. DeMartini, of the United States Public Health Service, led a short discussion on the provisions and administration of the Federal stream pollution bill passed by the 80th Congress. R. S. Hummel, district engineer at Richmond, and George C. Rothrock, assistant engineer for construction at Washington, both of the Federal Works Agency's Bureau of Community Facilities, discussed briefly the procedure to be followed by municipalities in applying for sewage works planning and construction funds authorized by the law, when and if such funds are actually made available for disbursement.

At the Annual Dinner Thursday night the principal speaker was the Honorable John Clark, Chairman of

the Maryland Resources Board and also Commissioner of Maryland Tidewater Fisheries.

The Friday morning technical session was opened with a paper by Reid W. Digges, manager, Hampton Roads Sanitation District Commission, Norfolk, on "Licking the Oil Pollution Problem in the Hampton Roads Area." L. G. Rich, instructor in sanitary engineering at Virginia Polytechnic Institute, gave a paper entitled "Caution! Bugs at Work," in which he traced the chemical and biological changes in a stretch of the James River below Big Island, Va., which receives semi-chemical pulping wastes.

The last presentation on the technical program was a talk by W. B. Hart, of the Atlantic Refining Company, Philadelphia, on "Industry's Current Attitude and Progress Toward Stream Pollution Abatement." Citing numerous instances of work now underway toward solving industrial pollution problems, he stated industry was adopting the attitude that waste treatment is a necessary and inescapable factor in consideration of plans for new plants or plant expansions in those states where regulatory agencies exist, but that a firm stand on the part of these agencies will be necessary before any wholesale abatement of existing industrial pollution may be expected.

Inspection trips Friday afternoon were made to the District of Columbia's Blue Plains sewage treatment plant, guided by Ralph E. Fuhrman, superintendent, and to the Pentagon Building sewage treatment plant, guided by William L. Torrey, Engineer in Charge, and Colonel Lester V. Johnson, formerly building engineer of the Pentagon Building.

The following officers were elected for 1949:

President: Bryant W. Strother, Richmond, Va.

Vice-President: J. A. Rives, Blacksburg, Va.

Secretary-Treasurer: A. H. Paessler, Richmond, Va.

A. H. PAESSLER,
Secretary-Treasurer

IOWA SEWAGE WORKS ASSOCIATION

1948 Annual Meeting

Des Moines, Iowa, September 14–15, 1948

The 1948 Annual Meeting of the Iowa Sewage Works Association was held at the Hotel Kirkwood, Des Moines, Iowa on September 14–15, 1948. Registration totaled 86 members and guests. The opening session was called to order by Chairman Lloyd Heller, following which Arthur Brayton, Convention Bureau, Des Moines, Iowa, gave the address of welcome.

The first technical session opened Tuesday afternoon with a paper by Dr. Hugh L. Templeton, technical director, Fairmont Foods Company, Omaha, Nebraska, on "Treating Cannery Wastes." Other papers presented at this session were:

"Treating Packing House Wastes," by R. W. Bates, Chemical Research and Development Department, Armour and Company, Chicago, Illinois.

"Operation and Research of Filters," by Willis L. Ogden, Yeomans Brothers, Chicago, Illinois.

"Financing Sewers and Sewage Treatment Plants," by The Honorable Cor Van de Steeg, Mayor, Orange City, Iowa, and attorney at law.

The well-attended annual banquet

featured entertainment by artists of radio station WHO. W. H. Wisely, executive secretary-editor, FSWA, as the main speaker of the evening discussed the subject "Public Relations and the Sewage Works Operator."

The Wednesday morning technical session was opened by an Operators' Breakfast, which was conducted under the chairmanship of Paul Bolton, assistant engineer, Iowa State Department of Health, Des Moines. Discussion leaders were: W. H. Wisely, executive secretary, FSWA; Paul Winfrey, superintendent, municipal sewage works, Des Moines, Iowa; Lloyd Heller, chief engineer, municipal sewage works, Ft. Dodge, Iowa; and Russell Martin, chemist, municipal sewage treatment works, Marshalltown, Iowa. Following the breakfast, R. E. Koon, associate, Stevens and Koon, consulting engineers, Portland, Oregon, presented an excellent talk on "Thirty Years of Experience in the Development of Domestic and Industrial Wastes in the Pacific Northwest."

The Wednesday morning technical session was concluded by a panel discussion on the following topics: Imhoff Tanks; Separate Sludge Digestion; and Activated Sludge.

The Wednesday afternoon session opened with panel discussions on "Overloaded Plants and Digesters." Leaders for this discussion were: C. T. Wilson, superintendent, municipal sewage works, Waterloo, Iowa; Russell Peterson, superintendent, municipal sewage works, Esterville, Iowa; Ralph Briley, chief operator, sewage treatment works, Ames, Iowa; and Walter Trockmorton, superintendent, municipal sewage works, Stormlake, Iowa. Other papers presented in this session were:

"Redesigning Overloaded and Out-of-Date Plants," by L. E. Miller, engineer, Leon L. Schoel and Associates, Spencer, Iowa.

"Training Sewage Works Personnel," by Prof. W. E. Galligan, Sanitary and Civil Engineering Department, Iowa State College.

"Licensing Sewage Works Personnel," by L. F. Skorezeski, superintendent, sewage treatment works, Marshalltown, Iowa.

The following officers were elected for the Association at the business meeting:

President: Lloyd Heller, Ft. Dodge
Vice-President: Paul Bolton, Des Moines
Secretary-Treasurer: Leo Holtkamp, Webster City

LEO HOLTKAMP,
Secretary-Treasurer

ROCKY MOUNTAIN SEWAGE WORKS ASSOCIATION

12th Annual Meeting

Cheyenne, Wyoming, September 15, 1948

The 12th Annual Meeting of the Rocky Mountain Sewage Works Association was held at the Plains Hotel, Cheyenne, Wyoming, on September 15, 1948. The 51 members and guests attending the conference enjoyed what is believed to be the best annual meeting which the Association has held.

The following papers were presented at the technical sessions:

"The Collection System and Its Maintenance," by Charles Davis, Denver.

"The Grit Chamber," by L. C. Osborn, Denver, Colo.

"Settling Tanks," by Carroll H. Coberly, Denver, Colo.

"Trickling Filters," by F. M. Veatch, Kansas City, Mo.

"Sludge Digesters," by B. V. Howe, Denver, Colo.

"Laboratory Procedure," by George Turre, Denver Water Company, Denver, Colo.

"Revenue Bonds and Financing," by L. O. Williams, Jr., Cheyenne, Wyo.

"The Overall Picture," by Lewis Dodson, Director, Sanitation Division, Denver County Health Department, Denver, Colo.

At the annual business meeting considerable discussion occurred concerning the desirability of instituting an award certificate for excellence of plant operation. A committee was appointed to study this proposal.

Association officers elected for 1949 were:

President: Charles G. Caldwell, Santa Fe, N. M.
Vice-President: Carl M. Bennett, Grand Junction, Colo.
FSWA Director: L. O. Williams, Cheyenne, Wyo.
Secretary-Treasurer: Carroll H. Coberly, Denver, Colo.

CARROLL H. COBERLY,
Secretary-Treasurer

MICHIGAN SEWAGE WORKS ASSOCIATION

23rd Annual Meeting

Detroit, Michigan, October 18–21, 1948

In lieu of the usual annual technical conference, the Michigan Sewage Works Association served as host to the 1948 Federation Convention at Detroit. A total of 137 men and 27 women residing in Michigan attended the Federation convention.

The only Michigan event held separately from the Federation functions was the annual smoker-dinner and business meeting at the Prince Edward Hotel, Windsor, Ontario on the evening of October 19. This stag event was attended by 112 members and guests.

Following the dinner President T. J. Powers introduced Federation officers George S. Russell, Arthur Niles, and W. H. Wisely, who spoke briefly on Federation activities and complimented the Michigan Association for the excellent work which the Local Arrangements Committee had contributed to the Detroit meeting. Dr. A. E. Berry, Secretary-Treasurer of the Canadian Institute on Sewage and Sanitation, welcomed the group to Canadian soil and bespoke the harmonious relationship and common objectives of the two Associations.

The formal business session consisted of the election of officers and presentation of committee reports. Reports were submitted by the following: D. M. Pierce, Secretary-Treasurer of the Association; W. F. Shephard, the Association's representative on the Federation Board of Control; L. F. Oeming, Chairman of the Membership Committee; J. E. Cooper, Chairman of the Education Committee; C. P. Witcher, Chairman of the Resolutions Committee; and R. A. Greene, Chairman of the Nominations Committee.

Officers elected for the year 1949 were:

President: A. T. Kunze, Wyandotte
Vice-President: Leonard Hillis, Caro
Secretary-Treasurer: Donald M. Peirce, Lansing
FSWA Director (1950–53): L. F. Oeming, Lansing

Following the election of officers, W. F. Shepard was selected to receive the 1949 Arthur Sherman Bedell Award in recognition of his years of leadership and service to the Michigan Association.

DONALD M. PIERCE,
Secretary-Treasurer

CANADIAN INSTITUTE ON SEWAGE AND SANITATION

15th Annual Meeting

Ottawa, Canada, November 1–3, 1948

The Canadian Institute on Sewage and Sanitation held its 15th Annual Meeting on November 1–3, 1948 at the Chateau Laurier in Ottawa. Registration for the meeting totaled 314 members and guests.

The technical sessions opened Monday morning with a paper by A. J. E. Smith, assistant supervisor, Ontario Region, Central Mortgage and Housing Corp., Toronto, Ont., on "Planning and Coordination of Municipal Utilities and Housing Projects." A guided discussion on "Problems in the Use of Combined Sewers" concluded the morning session.

At the annual Institute luncheon addresses were given by Dr. G. M. Geldert, Acting Mayor, City of Ottawa, and George S. Russell, Past-President, FSWA.

The afternoon technical session was opened by a paper on "Garbage Grinding in the Home," presented by Morris M. Cohn, Schenectady, N. Y. W. F. M. Bryce, Ottawa, Ont., discussed the Ottawa sewerage system. The afternoon session was concluded with guided discussions on "Sewage Pumping Stations" and "Operating Problems in Sewage Treatment Plants." The discussions were led by L. G. McNeice, Orillia, Ont., and W. M. Veitch, London, Ont., respectively.

The second day sessions opened with a business meeting at which time the reports of the Secretary-Treasurer and various committees were received. Following the election of officers, refuse collection practice was discussed by N. MacNicol, Forrest Hill, Ont., and Jean Asselin, Montreal, Que. A guided discussion on "Local Improvements and Other Methods of Financing Sewage Works," led by Chairman W. Storrie, Toronto, concluded the morning session.

Tuesday afternoon was devoted to an inspection and sight-seeing trip to places of interest in Ottawa and its environs. The annual banquet Tuesday evening featured the presentation of awards and certificates.

The concluding technical session of the Institute consisted of a symposium on sludge disposal, during which L. F. Roberton, London, Ont., spoke on liquid sludge as a fertilizer; I. H. Nevitt, Toronto, Ont., spoke on sludge digestion; and E. H. Munroe, York Township, Ont., discussed sludge dewatering. R. J. Desmarais, Windsor, Ont., was the Chairman of the guided discussion on miscellaneous sanitary problems which closed the last session of the Institute.

The following officers were elected by the Institute for 1949:

President: T. M. S. Kingston, Chatham, Ont.

Vice-President: L. G. McNeice, Orillia, Ont.

Secretary-Treasurer: A. E. Berry, Toronto, Ont.

A. E. BERRY,
Secretary-Treasurer

NORTH CAROLINA SEWAGE WORKS ASSOCIATION

20th Annual Conference

Asheville, N. C., November 8–10, 1948

The 20th Annual Meeting of the North Carolina Sewage Works Association was held at the George Vanderbilt Hotel, Asheville, N. C., on November 8–10, 1948, in conjunction with the 28th Annual Conference of the North Carolina Section, AWWA. Total registration for the joint meeting was 240.

The first three half-day sessions of the technical program were devoted to water works topics. The sewage works program, opening on Tuesday afternoon, November 9, featured a round table discussion that aroused spirited participation and interest. Prof. E. T. Chantlett served as leader of the forum, and was assisted by a panel consisting of Messrs. Earle Wax, R. S. Phillips, W. G. Brown and George S. Rawlins. A broad variety of sewage works topics was covered with such success that the session was extended and hour past the scheduled adjournment time.

Three papers made up the concluding session on Wednesday morning, November 10: "Operating Details of Sewage Treatment Plants," by W. H. Wisely; "Use of the Activated Sludge Process in Small Plants," by F. L. Bunker; and "Relation of Industrial Plant Changes to River Conditions," by F. V. Doutt.

At the Annual Banquet on November 9, it was announced that William McKinney Piatt, veteran consulting engineer, had been nominated by the association for the 1949 Arthur Sherman Bedell Award of the Federation. The Ludlow Cup, awarded annually to the member of the association who secures the greatest number of new members, was presented for the second year in succession to E. L. Nance of Charlotte.

Officers elected at the business session were R. W. Luther of Elizabeth City, *Chairman;* E. R. Tull of Rockingham, *Vice-Chairman;* E. C. Hubbard of Raleigh, *Secretary-Treasurer;* and R. S. Phillips of Charlotte, *FSWA Director (1950–53).* Plans were laid at this time to develop a sewage works short course for plant operators, to be supplemented later by an operators' certification system.

E. C. HUBBARD
Secretary-Treasurer

MEMBER ASSOCIATION MEETINGS

Association	*Place*	*Time*
Virginia Industrial Wastes and Sewage Works Association	Natural Bridge Hotel, Natural Bridge, Va.	March 31–April 1, 1949
Arizona Sewage and Water Works Association	Hassayampa Hotel, Prescott, Ariz.	April 1–3, 1949
Montana Sewage Works Association	Johnson Hotel, Great Falls, Mont.	April 7, 1949
Arkansas Water and Sewage Conference	Marion Hotel, Little Rock, Ark.	April 11–13, 1949
Kansas Sewage Works Association	Bizonite Hotel, Hutchinson, Kan.	April 21–22, 1949
Maryland-Delaware Water and Sewerage Association	Hotel Alexander, Hagerstown, Md.	April 28–29, 1949
Pacific Northwest Sewage Works Association	Bellingham, Wash.	May 11, 1949
California Sewage Works Association	Hotel Stockton, Stockton, Calif.	May 19–21, 1949
Michigan Sewage Works Association	Park Place Hotel, Traverse City, Mich.	May 23–25, 1949
New England Sewage Works Association	Bristol Country Club, Bristol, Conn.	May 25, 1949
New York State Sewage Works Association (Spring Meeting)	Governor Clinton Hotel, Kingston, New York	June 6–7, 1949
Central States Sewage Works Association	Hotel Sherman, Chicago, Ill.	June 17–18, 1949
Institute of Sewage Purification (Summer Conference)	Harrogate, England	June 20–24, 1949
Ohio Sewage and Industrial Wastes Treatment Conference	Carter Hotel, Cleveland, Ohio	June 22–24, 1949
Pennsylvania Sewage Works Association	Nittany Lion Inn, State College, Pa.	Aug. 24–26, 1949
Iowa Sewage Works Association	Hotel Kirkwood, Des Moines, Ia.	Sept. 20–22, 1949
Georgia Water and Sewage Association	Georgia Institute of Technology, Atlanta, Ga.	Sept. 21–23, 1949
West Virginia Industrial Wastes and Sewage Works Association	Ogleby Park, Wheeling, W. Va.	Sept. 21–23, 1949
Canadian Institute on Sewage and Sanitation	McIntyre Arena, Schumacher, Ontario, Canada.	Sept. 26–28, 1949
Federation of Sewage Works Associations	**Hotel Statler, Boston, Mass.**	**Oct. 17–20, 1949**
New England Sewage Works Association	Hotel Statler, Boston, Mass.	Oct. 17–20, 1949

Reviews and Abstracts*

A British Standard Specification for Media for Percolating Filters. By B. A. Southgate. *The Surveyor*, **107**, 467–468 (Sept. 10, 1948).

The British Standards Institution has drawn up a standard specification for filtering media. Many tests were made on different classes of material.

Coke, coal, clinker, gravel, crushed stone and slag have given good service in percolating filters. Opinion is varied on the suitability of the various materials for treating liquids of various compositions. The size of medium to be selected is also subject to opinion.

The specifications make no recommendations as to size or type of media; the properties dealt with are uniformity of size, shape, freedom from dust or impurities, and durability.

Regarding size, in the new Specifications the "nominal maximum size" is used. A table has been prepared which shows the proportion by weight of the sample which must pass sieves of various sizes. There are eight nominal sizes between $\frac{1}{4}$ in. and $2\frac{1}{2}$ in.

Tests are specified which are intended to eliminate the use of material in the form of elongated pieces or flat slabs. These tests determine the "index of flakiness" and the "index of elongation." Values have been established for various sizes of media which must not be exceeded.

While it is recognized that it is important that dust be excluded from the medium to be placed in a filter, the high limit of 5 per cent is given in the specifications. This was used because of dust formed in transit with some materials. If dust is present in any substantial amount the material should be placed by forking or should be screened or washed.

Several types of tests to determine the physical properties of various materials were considered. These were abrasion, crushing, and the sodium sulfate test. Only the sodium sulphate test was adopted as part of the specifications.

T. L. Herrick

Accepting Trade Effluents into Sewers. (Comments on a South African Scheme.) By John Hurley. *The Surveyor*, **107**, 459–463 (Sept. 3, 1948).

This article comments at length on a paper recently presented by C. J. Dekema at Salisbury, Southern Rhodesia. The paper, "The Implications of Accepting Trades Waste in Sewers," describes the procedure developed at Germiston, Transvaal. Part of the paper is devoted to a discussion of practice in other countries.

The rapid increase in industrial activity in the Union of South Africa is indicated by the fact that 3,820 new companies were registered in 1946.

As a general policy it is recommended that the local authority require the manufacturer to insure his wastes do not damage the sewerage system. This might include control of temperature, rate of discharge, and pH value. There might well be added the requirement that the trades waste do not contain coarse or heavy solids, or dangerous concentrations of substances which might produce inflammable or lethal atmospheres in or near the sewers.

It is also recommended that the local authority insist on the manufacturer providing pretreatment to insure that his wastes be "treatable" at the sewage works. Secondly, it is recommended that the charge to the manufacturer be based on the load contributed. This charge would be based on a 3-part formula including, (1) pumping costs, (2) sewage treatment costs, and (3) sludge treatment costs.

The comment is made that it would be costly to apply the scheme to all plants. In the case of small discharge perhaps a "flat-rate" charge might be made.

T. L. Herrick

* Please send to Federation headquarters all periodicals, bulletins, special reports, etc., which might be suitable for abstracting in This Journal. Publications of public health departments, stream pollution control agencies, research organizations, and educational institutions are particularly desired. Address such material: Federation of Sewage Works Assns., 325 Illinois Bldg., Champaign, Ill.

High Rate Trickling Filters. *The Surveyor*, **107,** 511–512 (Oct. 1, 1948).

This article is a summary of the discussions at the annual summer conference of the Institute of Sewage Purification on the paper by S. A. Greeley, "Considerations and Procedures in the Design of High Rate Trickling Filters." * The paper was introduced by John Hurley.

It was noted in the discussions that modern high rate filtration was brought to the attention of the members in 1937 when Harry N. Jenks presented his paper "The Renaissance of the Percolating Filter." The question of patents appeared peculiar, since recirculation was started in this country. The process was used a good many years ago on trade wastes, particularly gas liquors, but did not find favor in sewage treatment.

It is generally conceded that recirculation increases the removal of B.O.D. from the applied sewage. Costs of treatment are increased and it must be determined whether or not the increase is merited. The paper was helpful as regards this question, though American conditions are covered.

In a study of the paper it should be remembered that American sewages are weak and that the removal accomplished would be regarded as a low degree of purification in this country. As is known, the first part of the treatment is easily accomplished. Additional purification becomes more and more costly. "Two processes could only be compared when they were giving the same degree of purification."

It was pointed out that in addition to its use on gas liquors, recirculation was employed in England in 1927 during large scale experiments on the treatment of beet sugar wastes, and in 1935 during tests on the treatment of milk wastes.

There are quite a number of instances where recirculation has been used, among them the practice at Birmingham for about 15 years of recirculating effluent in order to improve the efficiency of sewage treatment. The principle of recirculation did not appear patentable.

Another member pointed out that biological treatment might not be the most suitable method where the proportion of trade wastes was high. Before the war, at Huddersford it was possible to obtain satisfactory results by double filtration at 2½ times the rate of single filtration. During the war this dropped to 1½, and it is very low at the present time due to the high chemical trade waste content of the sewage.

The opinion was expressed that most benefit from recirculation would be derived where the nitrification stage was reached. Interest was expressed as to the effect of severe winter conditions on the recirculation process.

In view of the great difference in water consumption in England as compared to the U.S.A., it was pointed out that dilutions in excess of 6 to 1 might be necessary to obtain conditions comparable to those in America.

T. L. HERRICK

High Rate Trickling Filters. *The Surveyor*, **107,** 523–525 (Oct. 8, 1948).

This article is a continuation of the discussion of Mr. Greeley's paper at a meeting of the Institute of Sewage Purification.

One member, in a discussion of patents, stated that "there was a time when American patents were looked upon with great respect in this country, because it was felt that a thorough search was made before patents were granted." That is no longer true. In recent years many "ridiculous" patents had been granted in America as well as in this country (England).

It was recalled that in 1926 when the filters of the Reading sewage works were badly clogged, experts had advised pumping effluent through them instead of river water from the Thames, as had been contemplated.

At Johannesburg, South Africa, recirculation has been practiced for a long time. Here too, filters have been operated at a rate of 2,000 gal. (Imp.) per cu. yd. per day, 4 times the Royal Commission Standard. It is not safe, however, to recommend these high rates under all conditions.

T. L. HERRICK

Report to the Street and Sewer Department on Sewage Treatment for the City of Wilmington, Delaware. BY WHITMAN, REQUARDT AND ASSOCIATES. Baltimore, Md., September, 1948. 108 pp. mimeo.

This report describes the sanitary situation in Wilmington, the necessary steps

* THIS JOURNAL, **20,** 5, 789 (Sept. 1948).

to effect improvement, the estimated costs of construction and operation, methods of financing and estimating charges for the sanitary services.

Wilmington has an area of about 16 sq. mi., and a present estimated population of 120,000, and a prospective population of 150,000 in a few years. One river and two creeks flow into the Delaware River within its boundaries.

Most of the built-up area is drained by combined sewers. A portion has separate systems. All the sewers (some 30 outlets) and drains empty into the watercourses except in the shell pot area, where a complete treatment plant (0.30 m.g.d.) was built in 1931. The problem is to remove the sewage and industrial flow from the watercourses and discharge the effluent into the Delaware River. All the sewage will be pumped to a single treatment plant, planned to remove grease and floating material and suspended solids; with digestion tanks (temporarily, lagoons).

The intereceptors, pumping stations, and discharge main are being planned for 100 years ahead (sic) and will carry considerable rain water.

The present average flow of sewage and wastes is estimated at 29 m.g.d.; the ultimate future flow at 66 m.g.d. The present maximum day flow is estimated at 52 m.g.d.; the future maximum at 128 m.g.d. The interceptors have a summation total of 190 m.g.d.

Rainfall occurs 4.37 per cent of the time. The interceptor will carry all the sewage flow but about 2 per cent. About one-third the total capacity of the interceptor-pumping-outfall system (60 m.g.d.) is for future growth and extension of area.

The sewage treatment plant will have an initial capacity of 40 m.g.d. of ordinary dry weather flow, although the plant units will pass 120 m.g.d.

All the industries must be connected to the system, except for clear, uncontaminated cooling waters.

The estimated cost of the interceptor-pumping-outfall system is $3,700,000, and of the treatment works, $3,300,000. The operating and maintenance cost, plus bond service (30-year bonds, 2¼ per cent interest), is estimated at $410,000 per year. The annual cost can be met by a sewer service charge equal to about one-half of the water bills, plus similar charges on those using other water sources than the city system.

The proposed treatment meets the (1940) requirements of Incodel.

The water supply of Wilmington is completely metered, and averages around 17.1 m.g.d. (domestic use only, 50 gal. per cap. p. d.). The principal industrial wastes are tannery, dairy and dairy products, textiles, and container board. Some copper and chromium wastes occur, but are not expected to make trouble in digestion. As flow of about 13 m.g.d. comes from outside the city water system, peak daytime sewage flows from 1.4 to 4.2 times the average daily water consumption were estimated.

Infiltration was estimated at a yearly average of 1,000 gal. per acre per day, with a maximum of 2,000 gal. per acre per day in wet seasons.

In general, the interceptors are planned for three times the dry weather flow (ultimate).

The two small existing treatment plants will be abandoned.

In the pumping station to handle flows from 10 to 160 m.g.d., five units are suggested, float-controlled, with two speeds, electrically driven. The force main is 6,500 ft. long; 84 in. in diameter.

The treatment plant comprises screens, grit removal, settling tanks, and sludge digesters. For the next 10 to 15 years, earth lagoons will be used for digesters.

Elutriation of sludge is proposed to counteract shots of industrial wastes.

Financing is suggested on a basis of 50 per cent general obligation and 50 per cent revenue bonds.

LANGDON PEARSE

The Inspection and Control of Trade Waste Effluent Discharge. By M. A. KERSHAW. *Journal of the Institution of Sanitary Engineers*, **Vol. XLVII,** Parts 2 and 3, July, 1948, pp. 49–62.

In the discussion, Townend describes the Mogden Works, which receives about one-eighth its total load from yeast factories. A charge is made to industries. One brewery recovers 2 tons of protein matter daily. Flexibility in regulations is desirable.

Lockett (at Mogden) found sterilization of a trade effluent desirable in hot weather. A plastic factory may present a phenol problem. Synthetic detergents are also

troublesome in dissolving material from sewage sludge and may require pretreatment.

Sciver points out the need of a special control where degreasing solvents are used, such as Ethylene trichloride, which is volatilized in sewers. Wastes from the manufacture of synthetic resin may cause deposits. Evans comments that gas liquor may require pretreatment to reduce loads on trickling filter. Williams doubts efficacy of attempts to control by correspondence.

The author agrees that gas liquor in excess of 2 per cent may cause trouble.

LANGDON PEARSE

Variations in B.O.D. Velocity Constants of Sewage Dilutions. BY C. C. RUCHHOFT, O. R. PLACAK, JOHN F. KACHMAR AND C. E. CALBERT. *Ind. Eng. Chem.* **40,** 1290–1295 (July, 1948).

The mean velocity constant usually associated with B.O.D. as $k = 0.1$ was found to be more nearly 0.15.

An intensive study to determine the exact k values was made by determining the B.O.D. values daily for 10 days of 59 sewages from domestic, military and hospital sources. The dilution water used was Theriault-Nichols, or formula C water, and the distilled water was stored for at least 5 days at room temperature and for 2 additional days in a 20° C. incubator. The ammonium sulfate was not added until the day the water was used.

In evaluating the data obtained, these were analyzed by three applications of the Thomas slope method; first using data for the first 7 days as observed at 1-day intervals; second, by using all 10-day results; and third, by using 10-day observations at 2-day intervals.

There was a wide variation in k values depending on the dilution used. There was no essential difference in the mean k value due to the source of the sample. In general, the lowest concentration of sewage gave the lowest k value, when comparing various dilutions. The mean k values for Cincinnati domestic, hospital, and military sewages were 0.152, 0.169, and 0.143, respectively. These data indicated that the mean k value was more nearly 0.15 than 0.10.

Curves were drawn plotting B.O.D. values *vs.* time of incubation, and nitrite determinations were made daily. The results suggested that the variation in k might be attributed to incubation concentration and to nitrification. The time of onset and amount of nitrification were shown to be important factors in the variation of the derived velocity constants. Nitrite formation also occurred earlier and more frequently in the lower concentrations of sewage when a comparison was made between various dilutions.

The conclusions drawn were:

"1. The general theory of clear-cut carbonaceous and nitrogenous stages in the B.O.D. reaction needs further study and considerable revision, particularly in its application to stream pollution problems.

"2. Application of blank seed sample demands as correction factors is an erroneous procedure and should be avoided.

"3. Nitrite and dissolved oxygen determinations should be made on all B.O.D. series that are to be used for the determination of reaction constants.

"4. Much work remains to be done on other factors besides dilution that may affect the onset of nitrification in sewage dilutions."

H. GLADYS SWOPE

Determination of Residual Chlorine in Sewage. BY HENRY C. MARKS AND ROBERT R. JOINER. *Analytical Chemistry,* **20,** 12, 1197–99 (December, 1948).

On sewage, new methods for the determination of residual chlorine showed that the widely used ortho-tolidine method was subject to errors. The ortho-tolidine method frequently fails to indicate a residual at low dosage ranges even though some degree of bacterial destruction is obtained. It has been concluded that much of the residual chlorine in sewage is present as organic chloramines and is not measured by the ortho-tolidine test. Two reasons for this have been suggested. (1) The chloramine might be sufficiently inert to leave certain types of chlorine demand unsatisfied but at the low pH of the test might become active enough to react with unsatisfied demand and therefore be dissipated. (2) The chloramine could react so slowly with the ortho-tolidine that fading would prevent complete color development. These two effects were dem-

onstrated on solutions of pure amino compounds and both may contribute to the error in the ortho-tolidine method when applied to sewage. Since there is more than one independent source of error in the ortho-tolidine determination the error will not be a constant one.

PAUL D. HANEY

Determination of Phenol and Structurally Related Compounds by the Gibbs Method. BY M. B. ETTINGER AND C. C. RUCHHOFT. *Analytical Chemistry*, **20,** 12, 1191–1196 (December, 1948).

In connection with stream pollution and water supply problems, analytical methods for phenolic materials should be sensitive to a few parts per *billion* of phenol or the cresols. In addition to sensitivity, speed and ease of determination are desirable. This paper presents a detailed study of factors affecting the determination of phenol, etc. by means of 2,6-dibromoquinone chloroimide (Gibb's reagent). Light absorption characteristics of the products of Gibbs' reaction were also studied.

The best results were obtained when the Gibbs reaction was carried out at room temperature with samples and standard maintained within ±1.0° C. at pH 9.4. The reaction time should be 18 to 24 hours. The reaction product is then extracted with normal butyl alcohol. Spectrophotometric examination of the colored reaction product is recommended. Extraction of the reaction product with normal butyl alcohol increases the sensitivity of the reaction.

An accelerated procedure carried out at 37° C. is described. This gives quick results at the sacrifice of accuracy.

The procedures described are adapted to the determination of phenol and ortho- and meta-cresols in aerobic, polluted river waters, but additional study will be required to develop the best procedures for their determination in industrial wastes. The procedures given are not suitable for the determination of para-cresol since this substance does not react with Gibbs' reagent. However, a semi-quantitative method for this substance is suggested.

On waters containing 100 parts per *billion* of phenol, etc., the procedures given are capable of results with probable errors of from ±1.7 to ±2.30 per cent.

Thirteen references.

PAUL D. HANEY

Lactic Acid from Fermentation of Sulfite Waste Liquor. BY REID H. LEONARD, W. H. PETERSON AND M. J. JOHNSON. *Industrial and Engineering Chemistry*, **40,** 1, 57–67 (January, 1948).

This paper presents detailed information on the results of an extensive study of the fermentation of sulfite waste liquor for lactic acid production. Sulfite waste liquor, a byproduct of the pulp and paper industry, was prepared for fermentation by steam-stripping followed by precipitation of the sulfite with calcium hydroxide. The liquor was then filtered and neutralized to pH 7 or lower with carbon dioxide. Following this preliminary treatment the sulfite waste liquor was inoculated with lactic acid-producing bacteria (*Lactobacillus pentosus*). These bacteria act upon the hexose wood sugar present in the liquor, producing about two mols of lactic acid from each mol of hexose. The best results were obtained at incubation temperatures of less than 37° C. The fermentation required about 48 hours for completion at 30° C. During fermentation the pH was controlled by the addition of calcium carbonate or calcium hydroxide. One of the most important factors in the fermentation process is the addition of a suitable auxiliary nutrient source. Nutrients influence to a considerable degree the rate and extent of fermentation. Malt sprouts appeared to offer the most promising material on the bases of cost and availability. The fermented liquor was concentrated, acidified, and extracted with a solvent for lactic acid recovery.

The sulfite waste liquor derived from the manufacture of about 1 ton of pulp from spruce wood will yield about 300 lb. of lactic acid. Costs for raw materials are estimated to be 2.5 to 3.4 cents per lb. of product, including some acetic acid production.

As a means of sulfite waste liquor utilization the lactic acid fermentation process compares favorably with other processes. The B.O.D. of the effluent from lactic acid production would be slightly greater than the effluent from yeast production. However, since 60 to 70 per cent of the liquid volume would be evaporated during re-

covery of the acid, it may be possible to utilize the residue for some purpose. Eleven tables; eight charts; four photographs; twenty-one references.

PAUL D. HANEY

Chemical Precipitation of Meat Packing Wastes. BY M. D. SANDERS. *Industrial and Engineering Chemistry*, **40**, 6, 1151–1152 (June, 1948).

Liquid waste from a meat packing plant may have a 5-day B.O.D. of from 500 to 2,000 p.p.m. derived from protein, fat and partly digested forage. The B.O.D. may be reduced 10 to 40 per cent by fat flotation, screening, and sedimentation. The remainder of the organic matter consists of emulsified fat and nitrogenous material. By chemical precipitation of the clarified waste, these components may be recovered in usable form.

The process described in this paper involves precipitation of proteins and fats at pH 4.0 to 5.2, and coagulation of this precipitate with iron (ferric) or aluminum salts. For maximum organic matter reduction the pH should be 4.8. The most practical chemicals to use are sulfuric acid and ferric sulfate. About 200 p.p.m. of sulfuric acid and 20 p.p.m. of ferric iron will be required. The waste treatment process described includes primary treatment followed by mixing, flocculating and sedimentation devices. The precipitate is withdrawn from the sedimentation tank and then heated (steam) to produce coagulation of solids which collect in a pasty layer at the surface of the liquid. The liquid portion is returned to the plant influent. The solids are dewatered to 75 to 85 per cent moisture. This product is suitable for use as an animal food ingredient.

The treatment described produces overall B.O.D. reductions of from 59.5 to 88.5 per cent. The effluent from a plant employing this treatment can be successfully handled on a trickling filter. With daily B.O.D. loadings of from 1,550 to 2,900 lb. per acre foot the trickling filter employed gave B.O.D. reductions of from 68 to 83 per cent. The filter was 6 ft. deep. The pH of the applied waste varied from 4.8 to 5.0.

The value of the product pays only a small part of operating, maintenance and fixed charges. If the fat and protein could be recovered separately these products would be much more valuable. Four references.

PAUL D. HANEY

Storage Studies on Kraft Mill Wastes. BY W. A. MOGGIO. Engineering Experiment Station Bulletin, Series No. 13, Louisiana State University, Baton Rouge, La. (1948).

This 26-page bulletin is a report of an investigation of the storage studies on kraft mill wastes. The effects of three variables on the treatment of kraft mill diffuser waste water by storage were studied and reported. The variables studied were: effect of bacterial seeding; effect of pH adjustment; effect of adding nitrogen salts.

Seeding of the waste, using storage pond sludge, contents of cow's rumen, and lake mud, proved effective in accelerating the initial removal of B.O.D. from the waste. The seed developed from the cow's rumen appeared slightly superior to the others. Total B.O.D. removal at the end of the storage period (40–50 days) was essentially equal in the seeded and unseeded samples. However, the so-called unseeded samples eventually became seeded through natural contamination.

Adjustment of the initial pH of the seeded waste to a range of pH 7–9 was effective in accelerating initial removal of B.O.D. from the wastes. The unadjusted control with a pH of 10 exhibited an appreciable lag in B.O.D. removal until 30-days storage, following which the removal equalled that of the adjusted samples. The pH of all the samples of stored wastes eventually adjusted itself to essentially the same range, with the initially unadjusted controlled sample being the last to adjust itself to that level. It is believed that in order to allow decomposition to proceed uninhibited, an initial pH of below 9.0 is necessary.

Supplementing the seeded wastes with nitrogen in the form of organic nitrogen, nitrate nitrogen, and ammonia nitrogen exhibited widely divergent results. In the case of organic nitrogen, because of the added organic load created by peptone, B.O.D. removal figures can not be compared favorably. It may be stated that at the end of 50-days storage as much B.O.D. remained as was contained in the

original waste at the beginning of storage. Addition of ammonia nitrogen exhibited a slightly greater percentage of B.O.D. removal than did the control which had no nitrogen added to it. The nitrate nitrogen sample exhibited excellent B.O.D. removal, with a very high immediate removal rate. The addition of nitrate to seeded waste gave results far exceeding the efficiency of removal exhibited by any of the other variables. However, the high rate of B.O.D. removal effected by the added nitrate salt is undoubtedly due to the source of easily available oxygen it furnished. Therefore, the addition of nitrogen itself in the form of salts is of little value in accelerating the removal of B.O.D. from seeded wastes.

S. C. MARTIN

Steel Mill Wastes Converted from Nuisance to Profit. Staff Report, *Chemical Industries*, **63**, 784–5 (Nov., 1948).

The Wheatland Tube Company and Wheatland Steel Products Company have established the Maneely Chemical Company to process waste pickle liquor with zinc wastes from galvanizing. A $500,000 plant is expected to be in operation by January, 1949.

The zinc wastes consist of metallic zinc, zinc oxide, zinc oxychloride, ammonium chloride, iron, and other waste matter. Metallic zinc is recovered by crushing and screening. The residue is roasted to convert all the zinc to zinc oxide.

Waste pickle liquor is stored in a 20,000-gal. acid-brick tank. It is clarified in 2,000-gal. batches in a glass-lined reactor by treatment with 200 lb. of impure zinc oxide. This neutralizes the free acid and precipitates the ferric iron as a gelatinous floc. The suspended matter is removed on a string filter and discarded.

The clear solution is treated at 100° C. in a glass-lined reactor with 3,500 to 4,000 lb. of zinc oxide. The mixture is agitated, and chlorine is added through the bottom of the kettle. The zinc oxide tends to lower the pH, and the chlorine tends to raise it, so addition of the latter is automatically controlled to hold the pH between 4.0 to 6.2. This range insures the precipitation of ferric iron but avoids the precipitation of ferrous iron. The reaction requires about 3 hours for completion, as marked by precipitation of all the iron.

The slurry is filtered and the cake dried in a Raymond flash drier. The product is a bright orange hydrated ferric oxide valuable for conversion to high grade pigments.

The filtrate is passed through a polishing filter to a double-effect morel evaporator where it is concentrated to the point at which zinc sulfate crystallizes as the hexahydrate. The salt is filtered off and dried in a drum drier. Evaporation of the filtrate is continued further to precipitate an impure mixture of zinc salts, and zinc chloride is finally obtained as a 70 per cent solution.

Building and equipment will be depreciated over 10 years; 20 per cent of the operating cost has been allowed for administration and contingencies, and 10 per cent of gross revenue for selling expense. Material losses of 10 per cent have been provided for. On the basis of conservative estimates, the process should operate at a profit.

RICHARD D. HOAK

Recover Usable Water from Waste by Extracting Condensable Gases. BY JOHN C. ALBRIGHT. *Petroleum Processing*, **3**, 1116 (November, 1948).

A simple stripping column and accessory equipment, recently installed by Union Oil Company of Calif. in its Wilmington refinery for removing hydrogen sulfide and ammonia from plant waste water, is reported to be giving satisfactory service.

The process used to extract the gases is a simple fractionating unit. Its operation is virtually automatic, and the still bottoms contain no trace of hydrogen sulfide and only a small percentage of ammonia. The process consists of a waste-gathering system; a horizontal accumulator with an interface level transmitter; a duplex reciprocating steam pump, with a spare; a conventional shell-and-tube heat exchanger; a stripping column, 4 ft. in dia. by 30 ft. high, containing 12 bubble plates; and an overhead partial condenser from which the contaminents are removed.

In operation, the feed is heated to 220° F. and the stripped water cooled in the exchanger. The feed enters the column at the midpoint. Saturated steam at 20 p.s.i. is introduced at the base of the column to maintain a temperature of

240° F. Water vapor, H_2S, and NH_3 leave the top of the column, at 8 p.s.i. and 227° F., through a vapor line to a partial condenser. Reflux from the condenser is returned at 140° F. near the top of the column to control top temperature and to strip residual compounds from the recycle.

About 1,400 bbl. per day of waste water, containing 3,600 lb. H_2S and 4,800 lb. NH_3, yields 1,810 bbl. of still bottoms containing no H_2S and only 500 lb. per day of ammonia. The increase in bottoms over charge is accounted for by the 410 bbl. of water added as process steam.

RICHARD D. HOAK

Answers to Stream Pollution Problems Sought. Staff Report, *Chemical and Engineering News*, **26**, 51, 3751 (December 20, 1948).

This article reports a symposium held at the Chemical Engineers' Club of Washington on December 6, 1948. State and federal agencies, technical consultants, and industry were represented in the discussions. The fallacy of a generalized answer to stream pollution problems was repeatedly emphasized.

The Maryland stream pollution program was described by a member of the water pollution control organization. The approach to the stream pollution problem in Maryland has consisted of a fact-finding program plus an invitation to those involved to reduce pollution to appropriate levels.

Pollutants which upset a stream's oxygen balance were considered to be the number one problem by one speaker. They cause great difficulty when they exceed the stream's ability to supply their oxygen requirements.

About half of the oxygen demand load on the streams comes from industrial wastes. The most effective control of these wastes lies in the original development of the process. The waste control organization of a large chemical manufacturing company was described. The problem of stream pollution control is one calling for the coordinated efforts of industry, municipalities and sanitation agencies. Tennessee was cited as an example of a state having representatives of all three groups on its pollution control commission. Industry has a definite interest in stream pollution control since it is interested in the maintenance of supplies of clean process water.

A description of the federal water pollution control program established by Public Law 845 was presented by a representative of the U. S. Public Health Service who stressed that the federal program was designed to assist state and local groups. This speaker noted that there was a definite trend toward formation of interstate compacts. Public Health Service activities will be carried out in 14 major river basin areas.

PAUL D. HANEY

New Federal Pollution Control Act—Its Significance to Petroleum Refiners. By W. B. HART. *Petroleum Processing*, **3**, 827–28 (Sept., 1948).

After reviewing the various sections of the new Act (S–418), the author comments as follows:

"The important features of this act, insofar as industry, and particularly the petroleum industry, is concerned, all come in the first five sections. The act in itself is not nearly as strict as many of the state laws, but of course, it is national in scope. It is an act which could well stay on the books for years without much effect in the way of accomplishment. The wording of the act is rather vague; it is filled with the phrases, "Reasonable time," "Reasonable and equitable measures," etc. These statements say little, and leave wide open room for individual opinion as to what they mean. Consequently, the entire effectiveness of the Water Pollution Control Act appears to depend, as with many of our laws, upon its administration."

It is suggested that the Pollution Control Advisory Board authorized by the Act may adopt a policy of watchful waiting to see what state agencies will do. Under such circumstances, much state activity will consist in a scramble for the funds appropriated by the Act.

A second possibility is that the states may increase their pollution abatement activities through fear of action by the Surgeon General. Unless the Act is administered aggressively, it is likely that any spurt in state activity will be short-lived, because the Surgeon General can do little of his own volition until all steps requiring state agreement have been taken.

The author concludes that it will be some time before the various activities established by the Act can be organized. In the meantime, all industry can best serve itself by taking stock of its position, and its relationship with state agencies. The petroleum industry should carefully examine its position concerning wastes other than oils, and such standardized equipment as has led it to a feeling of security in connection with oil pollution. Some of this equipment may not be satisfactory if called upon to handle wastes other than those for which it was designed.

RICHARD D. HOAK

Sanitation and Sewage Treatment Progress in El Salvador. BY J. ALFONSO VALDIVIESO. *Journal of the Inter-American Association of Sanitary Engineering*, **1**, 4, 433–443 (April, 1948).

The bulk of the population of El Salvador is rural. Except for the capital, San Salvador, having a population of 167,000, there are no large cities. Except for one city of 40,000, the remainder are less than 25,000 in population.

Only two or three of the cities are financially able to carry on a well-planned program of sanitation improvements. A 1936 law requires each municipality to spend at least 5 per cent of its revenue for sanitation, but because of very limited income these funds are inadequate for financing works of any importance. Of greater value is the government aid to municipalities that is available for construction of public works, either in the form of direct grants or by having the Department of Public Works of El Salvador carry out the construction.

Except for the construction of a sewer system in San Salvador between 1922 and 1925, most sewerage work has been done since the organization in 1942 of the Inter-American Cooperative Service of Public Health (the organization promoted by the U. S. Government through the Institute of Inter-American Affairs).

Although there are now many towns with sewer systems, only two sewage treatment plants have been built, one a trickling filter plant at San Miguel, and the other an Imhoff tank-sand filter plant at Santa Tecla. As a result, the pollution of streams, particularly during the 6-month long dry season, has become a major problem.

RAY GOLLY

Book Review

Treatment and Disposal of Industrial Waste Waters. By B. A. Southgate. H. M. Sationery Office, York House, Kingsway, London, W.C. 2. First Edition, 1948. Price $3.65.*

This volume is the first book on this subject to be published in Great Britain in 35 years and constitutes a valuable addition to the industrial waste treatment literature. Divided into 19 chapters, the book contains 322 pages, plus index. It is bound in cloth, is 6 by 10 in. in size, and the layout and typography are adequate. Chapter headings and reference sources are:

Chapter Heading	Pages	English and European References[1]	American References
1 Polluting Effects of Industrial Waste Waters	13	13	12
2 Effects of Pollution on Use of Water	9	8	8
3 Effects of Pollution on Fish	20	34	15
4 Modern Methods of Treatment of Sewage	31	29	16
5 General Methods of Treatment and Disposal of Industrial Waste Waters	23	12	12
6 Coal Mining	8	22	5
7 Carbonization and Similar Processes	27	28	3
8 Copper and Copper Alloys	13	7	4
9 Pickling of Steel	9	15	12
10 Waste Waters Containing Chromates and Cyanides	19	14	14
11 The Textile Industries	25	30	15
12 Laundering	10	8	8
13 Manufacture of Leather	19	11	21
14 Paper Mills	17	19	19
15 Dairies and Milk Products Factories	14	5	7
16 Slaughterhouses and Manufacture of Fish Meal	15	4	24
17 Manufacture of Malt, Beer, Alcohol, and Yeast	15	15	22
18 Canning and Drying of Vegetables and Fruit	18	3	20
19 Miscellaneous Processes and Waste Waters	17	13	5
Index	5	—	—
Totals	327	290	242

[1] Including 50 German References.

* Obtainable from: British Information Services, 30 Rockefeller Plaza, New York 20, New York.

The book deals primarily with the general principles governing methods of treatment of industrial wastes rather than with the engineering details of particular installations. Various methods of treatment which have been tried in each industry are described, with a tabular summary of the results obtained included from which the success of the methods can be judged. Many of the data presented have been drawn from the work of the Water Pollution Research Laboratory, of which the author is the director, but they also include the chief results of others who have made significant contributions to the industrial waste treatment field.

A list of references to the more important published work on each subject is given at the end of each chapter. For the book as a whole, the data discussed have been taken in about equal proportions from American and British experience. For many individual subjects, however, data presented are predominately from British or American sources. Only 77 of the 532 references relate to work published since 1942, and in 6 chapters there are no references later than 1942.

Dr. Southgate's book is a significant contribution to the industrial waste treatment field and constitutes an excellent compilation and analysis of data pertaining to this subject. It undoubtedly will prove to be an invaluable reference volume for all those concerned, either directly or indirectly, with the solution of industrial waste disposal problems.

S. C. Martin

Federation of Sewage Works Associations

Annual Year Book and Directory

1949

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Charles Alvin Emerson	1941
*Arthur S. Bedell	1942
Julius W. Bugbee	1942
Langdon Pearse	1942
Charles Gilman Hyde	1943
Howard Eugene Moses	1943
Floyd William Mohlman	1944
Willem Rudolfs	1945
William John Orchard	1946
F. Wellington Gilcreas	1948

The Harrison Prescott Eddy Medal

The Harrison Prescott Eddy Medal is awarded annually to a member of any Member Association of the Federation "for outstanding research contributing in important degree to the existing knowledge of the fundamental principles or processes of sewage treatment, as comprehensively described and published during any stated year in SEWAGE WORKS JOURNAL." The award commemorates Harrison Prescott Eddy, a famous engineer and a pioneer in the art of sewage treatment.

Past recipients of the award are:

Harry Willard Gehm	1943
John Raymond Snell	1944
Lloyd R. Setter	1945
H. Heukelekian	1946
Richard Pomeroy and Fred D. Bowlus	1947
F. W. Kittrell and O. W. Kochtitzky, Jr.	1948

* Deceased.

The George Bradley Gascoigne Medal

The George Bradley Gascoigne Medal is awarded annually to a member of any Member Association of the Federation "for outstanding contribution to the art of sewage treatment works operation through the successful solution of important and complicated operational problems, as comprehensively described and published during any stated year in SEWAGE WORKS JOURNAL." This award is in memory of George Bradley Gascoigne, a prominent consultant from 1922 to 1940, who demonstrated an unusual interest in matters of sewage works operation.

Past recipients of this award are:

Kerwin L. Mick	1943
James T. Lynch and Uhl T. Mann	1944
John D. McDonald	1945
LeRoy Winfield Van Kleeck	1946
Leon S. Kraus	1947
David P. Backmeyer	1948

The Charles Alvin Emerson Medal

The Charles Alvin Emerson Medal is awarded annually to a member of any Member Association of the Federation "for outstanding service in the sewerage and sewage treatment works field, as related particularly to the problems and activities of the Federation of Sewage Works Associations in such terms as the stimulation of membership, improving standards of operational accomplishments, fostering fundamental research, etc." This award honors Charles Alvin Emerson, who served as President of the Federation from 1928 to 1941 and holds the distinction of being its first Honorary Member.

Past recipients are:

Floyd William Mohlman	1943
Willem Rudolfs	1944
Harold Warner Streeter	1945
F. Wellington Gilcreas	1946
Langdon Pearse	1947
LeRoy Winfield Van Kleeck	1948

The Kenneth Allen Award

From 1943 through 1948, meritorious personal service to the Member Associations of the Federation was recognized by the Kenneth Allen Award. The award was retired in 1948.

Recipients of this award have been:

1943

Name	*Member Association*
Harry Thornton Calvert	I. S. P. (England)
Edward F. Eldridge	Michigan
John Kurtz Hoskins	Federal
Fred Merryfield	Pacific Northwest
Edward P. Molitor	New Jersey
Robert S. Phillips	North Carolina
Alfred Henry Weiters	Iowa
William Homer Wisely	Central States

1944

Name	*Member Association*
Albert Edward Berry	Canadian
Van Porter Enloe	Georgia
Albert Legrand Genter	Maryland-Delaware
F. Wellington Gilcreas	New England
Charles A. Holmquist	New York
Dana Ewart Kepner	Rocky Mountain
Leon Benedict Reynolds	California
Wilson Waldo Towne	Dakota

1945

Name	*Member Association*
Howard Eugene Moses	Pennsylvania
George S. Russell	Missouri
Dario Travaini	Arizona
Frederick Holman Waring	Ohio
Joe Williamson, Jr.	Florida
Murray Alderson Wilson	Kansas

1946

Name	*Member Association*
E. J. M. Berg	Texas
Frank E. DeMartini	Federal
John R. Downes	New Jersey
Thomas J. Doyle	Michigan
John Henry Garner	I. S. P. (England)
Harold Benedict Gotaas	North Carolina
William P. Hughes	Pacific Northwest
Theodore R. Lovell	Iowa
George Martin	Central States

1947

Name	*Member Association*
William T. Knowlton	California
Floyd W. Pinney	Dakota
Gilbert R. Frith	Georgia
Clarence E. Keefer	Maryland-Delaware
Stuart E. Coburn	New England
Wellington Donaldson	New York
Henry J. Darcey	Oklahoma
Carroll H. Coberley	Rocky Mountain
William Storrie	Canadian Institute
William Merriam Cobleigh	Montana

1948

Name	*Member Association*
George W. Marx	Arizona
David Bryon Lee	Florida
William Q. Kehr	Missouri
F. Dean Stewart	Ohio
Francis DeSales Friel	Pennsylvania

The William D. Hatfield Award

The William D. Hatfield Award recognizes outstanding annual sewage works operation reports. Following the 1946 award, the Board of Control authorized identical awards for outstanding annual reports prepared (1) for plants serving less than 10,000 population, (2) for plants serving populations of 10,000 to 100,000, and (3) for plants serving populations of more than 100,000 persons.

Recipients of this award have been:

1946

Walter M. Kunsch

1947

Name	*Plant Population Classification*
F. E. Peterson	Under 10,000
John R. Szymanski	10,000 to 100,000
Warren H. Sleeger and George J. Schroepfer	Over 100,000

1948

Name	*Plant Population Classification*
F. E. Peterson	Under 10,000
Thomas T. Hay	10,000 to 100,000
Kerwin L. Mick	Over 100,000

Membership Prizes

Prizes for membership activity in its various Member Associations have been awarded by the Federation since 1943. The following Member Associations have received these prizes:

Association	*Year*
Federal Sewage Research Assn. and Central States Sewage Works Assn.	1943
Missouri Water and Sewerage Conf. and Central States Sewage Works Assn.	1944
Arizona Sewage and Water Works Assn. and Canadian Institute on Sewage and Sanitation	1945
Oklahoma Water and Sewage Conf. and Canadian Institute on Sewage and Sanitation	1946
Institute of Sewage Purification (Eng.) and Arkansas Water and Sewage Conference	1947
Pennsylvania Sewage and Industrial Wastes Association and West Virginia Sewage and Industrial Wastes Association	1948

Quarter Century Operators Club

The Quarter Century Operators Club is an informal group comprising Active or Corporate Members of any Member Association who had been engaged in sewage treatment works operation, on a full-time resident basis, twenty-five years prior to the date of their admission into the Club. The Club was created in 1941 under the sponsorship of Frank Woodbury Jones, who serves as its registrar. The roster:

Charles C. Agar
Reuben A. Anderson
Harry M. Beaumont
George C. Behnke
Julius W. Bugbee
Raymond G. Case

E. Sherman Chase
Stuart E. Coburn
Morris M. Cohn
Rodney E. Cook
Earl Devendorf
John R. Downes
Almon L. Fales
Harry M. Freeburn
Arnold H. Goodman
Wm. C. Hamm
William D. Hatfield
Charles C. Hommon*
Frank W. Jones
Harry J. Krum
Roy S. Lanphear
John V. Lewis
C. D. McGuire
Paul Mollitor, Sr.*
Arthur H. Niles
I. H. Nevitt
John R. Palmer
Wm. M. Piatt
Wm. A. Ryan
Theodore C. Schaetzle
Glenn Searls
John S. Simmerman
H. W. Streeter
S. L. Tolman
Edmund B. Wagner
Charles E. Wheeler, Jr.

ANNUAL MEETINGS AND CONVENTIONS

Annual Meeting Number	*Location*	*Date*
1	Chicago, Illinois †	October 16, 1928
2	New York, New York †	January 18, 1929
3	New York, New York †	January 14, 1930
4	New York, New York †	January 22, 1931
5	New York, New York †	January 22, 1932
6	New York, New York †	January 19, 1933
7	New York, New York †	January 18, 1934
8	New York, New York †	January 18, 1935
9	New York, New York †	January 16, 1936
10	New York, New York †	January 22, 1937
11	New York, New York †	January 21, 1938
12	New York, New York †	January 20, 1939
13	New York, New York †	January 18, 1940
	Chicago, Illinois ‡	October 3–5, 1940
14	New York, New York †	January 15, 1941
	New York, New York ‡	October 9–11, 1941
15	Cleveland, Ohio §	October 22–24, 1942
16	Chicago, Illinois §	October 21–23, 1943
17	Pittsburgh, Pa. §	October 12–14, 1944
18	Chicago, Illinois †	October 17–18, 1945
19	Toronto, Ont., Can. §	October 7–9, 1946
20	Philadelphia, Pa. †	October 10, 1947
	San Francisco, Calif. ‡	July 21–24, 1947
21	Detroit, Mich. §	October 18–21, 1948

* Deceased.
† Annual business meeting of Board of Control.
‡ Convention of membership-at-large.
§ Annual business meeting of Board of Control and convention of membership-at-large.

DIRECTORY OF COMMITTEES

1948–49

Constitutional Committees

(See Article VI of By-Laws)

Executive Committee of the Board of Control

V. M. Ehlers, *Chairman*

L. M. Fischer
L. D. Matter
A. H. Niles
R. D. Pomeroy
R. S. Rankin
G. S. Russell

General Policy Committee

The General Policy Committee studies and recommends to the Board of Control upon all matters of policy affecting the well-being and usefulness of the Federation and its Member Associations; matters of public relations; the advancement of and the professional and social status of members, and such other matters of similar nature as may be referred to it by the Board.

G. S. Russell, *Chairman*

George Martin
John R. Downes
Dana E. Kepner
E. F. Miltner
Kenneth Chrysler
William Storrie

Publications Committee

The Publications Committee arranges the technical programs for the annual conventions of the Federation and has general supervision of all publications of the Federation.

F. W. Gilcreas, *Chairman*

Rolf Eliassen
C. C. Larson
Carl E. Green
F. W. Mohlman
W. H. Wisely

Organization Committee

The Organization Committee examines and reports to the Board on applications for membership in the Federation and endeavors to encourage the formation of new regional associations or conferences eligible for membership.

Earnest Boyce, *Chairman*

C. R. Compton
R. H. Suttie

Sewage Works Practice Committee

The Sewage Works Practice Committee reviews and directs for publication any resolution, report or publication which establishes professional or technical standards in the name of the Federation.

Morris M. Cohn, *Chairman*

Norval E. Anderson	L. W. Van Kleeck
D. E. Bloodgood	Kerwin L. Mick
R. F. Brown	F. W. Mohlman
G. P. Edwards	A. H. Niles
F. W. Gilcreas	Langdon Pearse
K. V. Hill	Willem Rudolfs
C. E. Keefer	F. M. Veatch
C. W. Klassen	W. H. Wisely

Subcommittee on Use of Sludge as Fertilizer

This subcommittee of the Sewage Works Practice Committee was assigned to compile a manual of practice on "Utilization of Sewage Sludge as Fertilizer." The assignment has been completed and Manual of Practice No. 2 was published under the above title in November, 1946.

A. H. Niles, *Co-Chairman*

Langdon Pearse, *Co-Chairman*

F. W. Gilcreas	T. C. Schaetzle
F. W. Mohlman	L. W. Van Kleeck
Willem Rudolfs	W. H. Wisely

Subcommittee on Occupational Hazards

This subcommittee of the Sewage Works Practice Committee has been assigned to compile a Manual of Practice on "Occupational Hazards in the Operation of Sewage Works." The manual has been completed and was distributed to the membership in December, 1944.

L. W. Van Kleeck, *Chairman*

S. H. Ash	Fred R. Ingram
Reuben F. Brown	L. L. Langford
Joseph Doman	L. E. West

Subcommittee on Air Diffusion

This subcommittee of the Sewage Works Practice Committee has been charged with the duty of producing a Manual of Practice on "Air Diffusion in Sewage Treatment." The first draft of the manual is under review.

Norval E. Anderson, *Chairman*

A. J. Beck	W. F. Schade
G. P. Edwards	C. B. Townend
C. T. Mickle	J. J. Wirts

Subcommittee on Sewer Maintenance

This subcommittee of the Sewage Works Practice Committee has been directed to develop a Manual of Practice on "Maintenance of Sewers and Appurtenant Structures." The first draft of the manual is in preparation.

R. F. Brown, *Chairman*

Thos. B. Garry	B. H. Grout
W. H. Brown, Jr.	Roy E. Phillips
G. E. Finck	Richard Pomeroy
Grant Olewiler	Robert P. Shea
R. L. Patterson	John H. Brooks, Jr.
Henry Fitch	Forest Weber

Subcommittee on Chlorination of Sewage

This subcommittee of the Sewage Works Practice Committee has been assigned the development of a Manual of Practice on "The Use of Chlorine in Sewage Treatment." The manual is in a late stage of preparation.

F. W. Gilcreas, *Chairman*

N. S. Chamberlain
A. E. Griffin
H. A. Faber

Subcommittee on Standardization of Units

This subcommittee of the Sewage Works Practice Committee has been assigned to develop an approved schedule of units to be used in the reporting of plant operation and laboratory data. A committee of about forty members is at work.

Willem Rudolfs, *Chairman*

Subcommittee on Trickling Filters

This subcommittee of the Sewage Works Practice Committee is engaged in the development of a Manual of Practice to be entitled "Trickling Filters—Their Characteristics and Loadings."

Kenneth V. Hill, *Chairman*

B. F. Hatch
W. S. Mahlie
Wm. E. Stanley

Subcommittee on Sewer Ordinances

This subcommittee of the Sewage Works Practice Committee has been assigned the preparation of a Manual of Practice concerning the regulation and control of the usage of public sewers. The second draft of the manual is being prepared for final clearance prior to publication.

D. E. Bloodgood, *Chairman*

H. E. Babbitt
Fred J. Biele
R. F. Brown
M. M. Cohn
Charles A. Davis
C. E. Keefer
A. F. Lehman
A. H. Niles
B. A. Poole
J. L. Quinn
C. L. Siebert

Subcommittee on Sewage Works Accounting

This sewage works practice subcommittee was created in 1946 for the purpose of developing a manual of practice on accounting procedures for municipal sewage works functions. A preliminary draft of a comprehensive report on this subject is now being revised for distribution as a tentative manual of practice.

F. M. Veatch, *Chairman*

G. J. Beiswanger
Charles A. Davis
Alfred A. Estrada
E. A. Farmer
S. I. Zack

Subcommittee on Paints and Protective Coatings

This sewage works practice subcommittee has the function of assembling experience and data on paints and protective coatings used in sewage works, to be presented with recommendations in the form of a manual. The subcommittee was created in 1946 and is now collecting data on this subject.

Kerwin L. Mick, *Chairman*

Virgil Anderson
W. D. Hatfield
J. W. Johnson
W. T. McClenahan
F. W. Pinney
Walter A. Sperry
M. L. Robbins

Research Committee

The Research Committee has the function of stimulating research work among the various Member Associations, and of cooperating with other organizations in the promotion of research.

Willem Rudolfs, *Chairman*

H. E. Babbitt
D. E. Bloodgood
G. P. Edwards
H. A. Faber
A. L. Genter
H. Heukelekian
R. P. Logan
H. J. Miles
F. W. Mohlman
C. C. Ruchhoft
C. N. Sawyer
L. R. Setter
L. W. Van Kleeck

Subcommittee on Toxicity of Industrial Wastes

This subcommittee of the Research Committee is functioning in three sections:

Section I. Critical review of literature; Willem Rudolfs, *Chairman*, C. E. Barnes, P. Doudoroff, G. P. Edwards, H. Heukelekian, F. W. Kittrell, C. E. Renn and R. F. Weston.

Section II. Development of methods for toxicity determinations on wastes; J. A. McCarthy, *Chairman*, S. E. Coburn, G. P. Edwards, H. Heukelekian, E. Hurwitz, R. S. Ingols, C. C. Ruchhoft, W. W. Sanderson, C. N. Sawyer and R. F. Weston.

Section III. Development and standardization of bio-assay methods; P. Doudoroff, *Chairman*.

Finance Committee

The Finance Committee develops the annual operating budget of the Federation and affords guidance to the Board of Control in financial affairs.

W. J. Orchard, *Chairman*

V. M. Ehlers
G. S. Russell

Special Committees

Committee on Awards

The Committee on Awards was created by the Board of Control on October 11, 1941. Functions of the committee are to advise the Board on matters of award procedures and to make recommendations as to the annual winners of the Eddy, Gascoigne and Emerson Awards.

H. W. Streeter, *Chairman*

L. S. Kraus
G. A. Rohlich

Honorary Membership Committee

Authorized by the Board of Control on October 24, 1942, this committee comprises the President and four latest, living Past Presidents with the senior Past President as chairman. The committee reviews nominations for election to the grade of Honorary Member and makes recommendations to the Board on such nominations.

A. E. Berry, *Chairman*

V. M. Ehlers
F. S. Friel
J. K. Hoskins
G. S. Russell

Operation Reports Committee

The Operation Reports Committee was created by the Board of Control on October 11, 1941, to provide for Federation recognition of outstanding operation reports. The committee now administers the annual William D. Hatfield Award.

A. F. Dappert, *Chairman*

Wm. A. Allen
G. A. Hall

Operator's Qualifications Committee

Authorized by the Board of Control on October 11, 1941, the Operator's Qualifications Committee is assigned to "establish minimal qualifications for operators of various classes of treatment works." The committee also has the duty of collecting and compiling data on present procedures in the licensing and certification of operators, for reference to Member Associations.

L. W. Van Kleeck, *Chairman*

Benjamin Benas
T. C. Schaetzle

Industrial Wastes Committee

The Industrial Wastes Committee was created by the Board of Control on October 23, 1943, for the purpose of developing interest in this important field and to direct a program whereby the Federation may be of service in industrial waste problems.

F. W. Mohlman, *Chairman*

D. E. Bloodgood
H. W. Gehm
W. B. Hart
V. L. King
L. F. Oeming
Wm. S. Wise

Nominating Committee

The special Nominating Committee was created by the Board of Control on October 9, 1946, to function in an advisory capacity to the Election Committee. The Nominating Committee is to comprise the last five living Past Presidents, with the senior Past President as chairman.

A. M. Rawn, *Chairman*

A. E. Berry
J. K. Hoskins
G. S. Russel
F. S. Friel

Quarter Century Operators Club Committee

The special Quarter Century Operators Club Committee was created by the Board of Control on October 9, 1946. It is the function of this Committee to establish eligibility requirements, process membership applications, maintain the roster and supervise the activities of the Quarter Century Operators Club.

Frank W. Jones, *Chairman*

Stuart E. Coburn
Harold W. Streeter

Legislative Analysis Committee

The Legislative Analysis Committee was created by the Board of Control on October 17, 1945, to study legislation pertinent to the interests of the Federation and to serve the Board in advisory capacity.

Ralph E. Fuhrman, *Chairman*

C. E. Schwob
David B. Lee
L. D. Matter
R. L. Winget

Constitution and By-Laws Committee

The Constitution and By-laws Committee was created by the Board of Control on October 10, 1947, to review and develop recommendations for the amendment of the Constitution and By-laws of the Federation as may be deemed advisable under changing conditions.

C. A. Emerson, *Chairman*

F. S. Friel
F. W. Gilcreas
W. J. Orchard
G. S. Russell

Committee on Emergency Planning

Created in 1948, the Committee on Emergency Planning is the medium of Federation cooperation with Federal agencies and others in matters pertaining to sanitation requirements and practices in the event of national emergency or disaster.

C. W. Klassen, *Chairman*

M. R. Golly
W. A. Hardenbergh
David B. Lee
B. A. Poole

Committee on Sewer Revenue Rates and Rate Structures

The Committee on Sewer Revenue Rates and Rate Structures was created by the Board of Control in 1948 to study and advise the Board on matters of Federation policy appertaining to sewer revenue financing procedures.

G. J. Schroepfer, *Chairman*

H. R. Green
W. E. Stanley
M. W. Tatlock
F. M. Veatch

Joint Committees With Other Associations

Committee on Standard Methods of Sewage and Industrial Wastes Analysis

Created by the Board of Control on January 22, 1931, the Committee on Standard Methods of Sewage and Industrial Wastes Analysis has functioned with similar committees of the American Water Works Association and American Public Health Association in the production of the laboratory manual *Standard Methods for the Examination of Water and Sewage*. In 1947 the Federation became a joint publisher of this book with the above associations. The committee is presently engaged in a comprehensive research project on analytical methods, which work will continue for at least a year This project is being financed by a grant made through the National Institute of Health

W. D. Hatfield, *Chairman*

G. E. Symons
S. E. Coburn
D. E. Bloodgood
H. Heukelekian
G. P. Edwards
E. W. Moore

A. J. Fischer
F. W. Gilcreas
R. D. Hoak
Keeno Fraschino
W. S. Mahlie
R. S. Ingols
L. R. Setter
C. N. Sawyer
M. Starr Nichols
Richard Pomeroy
C. C. Ruchhoft
Willem Rudolfs
R. F. Weston
M. G. Mellon
L. K. Herndon
E. Hurwitz

COMMITTEE ON SEWAGE WORKS NOMENCLATURE

The Committee on Sewage Works Nomenclature was created by the Board of Control on January 22, 1937, to function with similar committees of the American Society of Civil Engineers and American Public Health Association. This Joint Committee on Definition of Terms Used in Sewerage and Sewage Disposal Practice is now engaged in the compilation of a "Glossary of Water and Sewage Control Engineering," in conjunction with the Joint Committee on Definition of Terms Used in Water Works Practice, which comprises the American Society of Civil Engineers, American Public Health Association and American Water Works Association.

C. J. Velz, *Chairman*

C. A. Emerson
C. E. Keefer

COMMITTEE ON WATER AND SEWAGE WORKS DEVELOPMENT

The Committee on Water and Sewage Works Development was organized in 1943 to promote the planning of water and sewage works and to encourage the inclusion of such projects in postwar planning programs. The committee, temporarily inactivated, comprises representatives of the Water and Sewage Works Manufacturers Association, American Water Works Association, New England Water Works Association and the Federation of Sewage Works Associations. Federation representatives are:

C. A. Emerson
G. J. Schroepfer

Special Convention Committees

CONVENTION MANAGEMENT COMMITTEE

The function of this committee is to supervise details of the management of the Annual Meetings of the Federation.

W. J. Orchard, *Chairman*

A. T. Clark
L. H. Enslow
F. L. Flood
W. H. Wisely

MEETING PLACE COMMITTEE

This committee reviews invitations received for the Annual Meetings of the Federation and makes recommendations to the Board of Control in regard to the time and place of such meetings.

V. M. Ehlers, *Chairman*

A. T. Clark
A. H. Niles
G. S. Russell
W. F. Rockwell
D. J. Saunders
W. H. Wisely

PUBLICITY AND ATTENDANCE COMMITTEE

The function of this committee is to prepare publicity releases in connection with the Annual Meetings of the Federation and to direct the distribution of such material.

L. H. Enslow, *Chairman*

M. M. Cohn W. A. Hardenbergh

SUMMARY OF MEMBERSHIP

(As at December 31, 1948)

Federation Members

Honorary Members	9
Associate Members	74
Member Associations	34
Active Members	4826
Alternate Active Members	11
Corporate Members	66

Net Membership of Member Associations *

Member Association	Active	Alternate Active	Corporate	Total
Alabama	11	—	—	11
Argentina	—	—	—	—
Arizona	37	—	5	42
Arkansas	34	—	—	34
California	349	—	—	349
Canadian Inst.	357	—	—	357
Central States	526	—	12	538
Dakota	45	—	—	45
Federal	136	—	—	136
Florida	99	—	—	99
Georgia	66	—	—	66
Iowa	73	—	—	73
ISE (Eng.)	36	—	—	36
ISP (Eng.)	206	—	—	206
Kansas	37	—	—	37
Kentucky-Tennessee	115	—	4	119
Maryland-Delaware	48	—	—	48
Michigan	199	6	2	207
Missouri	60	—	—	60
Montana	41	—	5	46
New England	252	1	—	253
New Jersey	132	—	—	132
New York	579	4	3	586
North Carolina	86	—	—	86
Ohio	237	—	4	241
Oklahoma	32	—	1	33
Pacific Northwest	171	—	—	171
Pennsylvania	397	—	19	416
Puerto Rico	27	—	1	28
Rocky Mountain	64	—	1	65
Switzerland	13	—	—	13
Texas	137	—	—	137
Virginia	92	—	6	98
West Virginia	132	—	3	135
Totals	4826	11	66	4903

* Not including Dual Members.

Directory of Members

MEMBER ASSOCIATIONS

Alabama Water and Sewage Association (Affiliated 1948).

Territory: State of Alabama.
President: Tom Collins; *Vice-President:* G. H. Godwin; *Director:* R. C. Barton *Treasurer:* G. H. Dunstan; *Secretary:* Alex. O. Taylor, c/o Alabama Polytechnic Inst., Auburn, Ala.

Argentina Society of Engineers, Sanitary Engineering Division (Affiliated 1936).

Territory: Republic of Argentina.
FSWA Contact Member: E. B. Besselievre, c/o The Dorr Co., Inc., 570 Lexington Ave., New York, N. Y.

Arizona Sewage and Water Works Association—Sewage Works Section (Affiliated 1928).

Territory: State of Arizona.
President: J. W. Rauscher; *First Vice-President:* A. A. Frederickson; *Second Vice-President:* George W. Marx; *Director:* R. T. Gardner; *Secretary-Treasurer:* Mrs. Helen Rotthaus, c/o Sanitary Engineering Div., Arizona State Dept. of Health, State Capitol Bldg., Phoenix, Arizona.

Arkansas Water and Sewage Conference—Sewage Works Section (Affiliated 1946).

Territory: State of Arkansas.
Chairman: Solon Sanderson; *Vice-Chairman:* Fay Peer; *Director:* F. L. McDonald; *Secretary-Treasurer:* Harrison Hale, 118 Chemistry Bldg., Fayetteville, Ark.

California Sewage Works Association (Affiliated 1928).

Territory: State of California.
President: Ray L. Derby; *First Vice-President:* R. R. Ribal; *Second Vice-President:* F. G. Nelson; *Director:* R. D. Pomeroy; *Secretary-Treasurer:* Lawrence H. Cook, P. O. Box 696, Menlo Park, Calif.

Canadian Institute on Sewage and Sanitation (Affiliated 1933).

Territory: Dominion of Canada.
President: T. M. S. Kingston; *Vice-President:* L. G. McNeice; *Director:* R. J. Desmarais; *Secretary-Treasurer:* A. E. Berry, Ontario Dept. of Health, Sanitary Engineering Div., Toronto 8, Ontario, Canada.

Central States Sewage Works Association (Affiliated 1928).

Territory: States of Illinois, Indiana, Wisconsin, and Minnesota.
President: C. B. Carpenter; *First Vice-President:* L. S. Kraus; *Second Vice-President:* H. T. Rudgal; *Third Vice-President:* M. L. Robins; *Director:* G. W. Martin; *Secretary-Treasurer:* Paul W. Reed, 1098 W. Michigan St., Indianapolis 7, Ind.

Dakota Water and Sewage Works Conference—Sewage Works Sections (Affiliated 1936).

North Dakota Section

Territory: State of North Dakota.
President: G. J. Toman; *Vice-President:* A. F. Hulteng; *Director:* Roy G. Spieker; *Secretary-Treasurer:* Jerome H. Svore, c/o State Dept. of Health, Bismarck, N. Dak.

South Dakota Section

Territory: State of South Dakota.
President: R. E. Bragstad; *Vice-President:* C. B. Madison; *Director:* Roy G. Spieker, *Secretary-Treasurer:* W. W. Towne, Div. of San. Eng., State Board of Health, Pierre, S. Dak.

Federal Sewage Research Association (Affiliated 1930).

Territory: Federal employees wherever stationed.
President: R. N. Clark; *Vice-President:* E. L. Ferguson; *Director:* L. M. Fisher; *Secretary-Treasurer:* Ralph C. Graber, U. S. Public Health Serv., Social Security Bldg., 4th & Independence, Washington, D. C.

Florida Sewage Works Association (Affiliated 1941).

Territory: State of Florida.
President: J. R. Hoy; *Vice-President:* S. K. Keller; *Director:* B. F. Borden; *Secretary-Treasurer:* Perry M. Teeple, Florida State Board of Health, P. O. Box 210, Jacksonville, Fla.

Georgia Water and Sewage Association (Affiliated 1936).

Territory: State of Georgia.
President: D. H. Hurst; *First Vice-President:* Clyde Angle; *Second Vice-President:* Van P. Enloe; *Director:* G. R. Frith; *Secretary-Treasurer:* L. E. Waller, Rte. 12, Box 264, Atlanta, Ga.

Iowa Sewage Works Association (Affiliated 1928).

Territory: State of Iowa.
President: Lloyd Heller; *Vice-President:* Paul Bolton; *Director:* John L. Strelow; *Secretary-Treasurer:* Leo Holtkamp, E. Ohio St., Webster City, Iowa.

Institution of Sanitary Engineers—England (Affiliated 1932).

Territory: British Empire.
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Institute of Sewage Purification—England (Affiliated 1932).

Territory: British Empire.
President: F. T. Hambleton; *Director:* W. F. Freeborn; *Federation Contact Member:* J. H. Garner, 28 Aberford Road, Wakefield, Yorks., England.

Kansas Sewage Works Association (Affiliated 1935).

Territory: State of Kansas.
Chairman: M. K. Nelson; *Vice-Chairman:* L. T. Hagadorn; *Director:* E. F. Miltner; *Secretary-Treasurer:* James B. Arbuthnot, c/o State Board of Health, Marvin Hall, University of Kansas, Lawrence, Kan.

Kentucky-Tennessee Industrial Wastes and Sewage Works Association (Affiliated 1946).

Territory: States of Kentucky and Tennessee.
Chairman: Grant S. Bell; *Vice-Chairman:* S. Leary Jones; *Director:* James Ellis; *Secretary-Treasurer:* R. P. Farrell, 420 Sixth Ave., N., Nashville 3, Tenn.

Maryland-Delaware Water and Sewerage Association—Sewage Works Section (Affiliated 1928).

Territory: States of Maryland and Delaware.
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Michigan Sewage Works Association (Affiliated 1930).

Territory: State of Michigan.
President: A. T. Kunze; *Vice-President:* Leonard Hillis; *Director:* W. F. Shephard; *Secretary-Treasurer:* D. M. Pierce, Michigan Dept. of Health, Room 334, Administration Bldg., Lansing 4, Mich.

Missouri Water and Sewerage Conference—Sewage Works Section (Affiliated 1929).

Territory: State of Missouri.
Chairman: P. E. Gamet; *Vice-Chairman:* H. O. Hartung; *Director:* A. H. Wymore; *Secretary-Treasurer:* Warren Kramer, c/o State Office Bldg., Jefferson City, Mo.

Montana Sewage Works Association (Affiliated 1944).

Territory: State of Montana.
Chairman: F. F. Palmer; *Vice-Chairman:* Chester Eyer; *Director:* K. L. Chrysler; *Secretary-Treasurer:* H. B. Foote, Div. of Sanitary Engineering, State Board of Health, Helena, Montana.

New England Sewage Works Association (Affiliated 1929).

Territory: States of Maine, New Hampshire, Vermont, Massachusetts, Connecticut and Rhode Island.
President: Walter H. Brown; *First Vice-President:* Ralph W. Horne; *Second Vice-President:* William S. Wise; *Director:* F. L. Flood; *Secretary-Treasurer:* Walter E. Merrill, c/o State Dept. of Health, 511A State House, Boston, Mass.

New Jersey Sewage Works Association (Affiliated 1942).

Territory: State of New Jersey.
President: Leslie West; *First Vice-President:* John Struss; *Second Vice-President:* Sol Seid; *Director:* L. J. Fontenelli; *Secretary-Treasurer:* Michael S. Kachorsky, P. O. Box 283, Manville, N. J.

New York State Sewage Works Association (Affiliated 1930).

Territory: State of New York.
President: Paul E. Bardet; *Vice-President:* John W. Johnson; *Director:* G. E. Symons; *Secretary:* Ralph C. Sweeney, State Dept. of Health, 19 E. Main St., Rochester 4, N. Y.; *Treasurer:* J. C. Brigham.

North Carolina Sewage Works Association (Affiliated 1929).

Territory: State of North Carolina.
Chairman: R. W. Luther; *Vice-Chairman:* E. R. Tull; *Director:* George S. Rawlins; *Secretary-Treasurer:* E. C. Hubbard, c/o State Board of Health, Raleigh, N. C.

Ohio Sewage and Industrial Wastes Treatment Conference (Affiliated 1932).

Territory: State of Ohio.
Chairman: E. F. Wittmer; *Vice-Chairman:* Robert Bowman; *Director:* A. H. Niles; *Secretary-Treasurer:* G. A. Hall, 302 Depts. of State Bldg., Columbus, Ohio.

Oklahoma Water and Sewage Conference—Sewage Works Section (Affiliated 1929).

Territory: State of Oklahoma.
President: C. E. Moutrey; *Vice-President:* Earl Wittmer; *Director:* Frank S. Taylor; *Secretary-Treasurer:* H. J. Darcey, State Dept. of Health, Oklahoma City 5, Okla.

Pacific Northwest Sewage Works Association (Affiliated 1933).

Territory: States of Washington, Oregon, and Idaho.
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Territory: State of Pennsylvania.
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Puerto Rico Water and Sewage Works Association (Affiliated 1947).

Territory: Puerto Rico.
President: Luis Ramos; *Director:* Alberto Hernandez; *Secretary-Treasurer:* Manuel Vinas-Sorba, 1555 Francia St., Santurce, Puerto Rico.

Rocky Mountain Sewage Works Association (Affiliated 1936).

Territory: States of Wyoming, Colorado, and New Mexico.
President: C. G. Caldwell; *Vice-President:* C. M. Bennett; *Director:* L. O. Williams; *Secretary-Treasurer:* Carroll H. Coberly, Room 329, 1441 Welton St., Denver 2, Colo.

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Territory: Switzerland.
President: A. Kropf; *Vice-President:* H. Bachoffner; *Director:* Walter Dardel; *FSWA Contact Member:* Walter Dardel, Aarberg (Berne), Switzerland.

Texas Water and Sewage Works Association—Sewage Works Section (Affiliated 1928).

Territory: State of Texas.
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Territory: State of Virginia.
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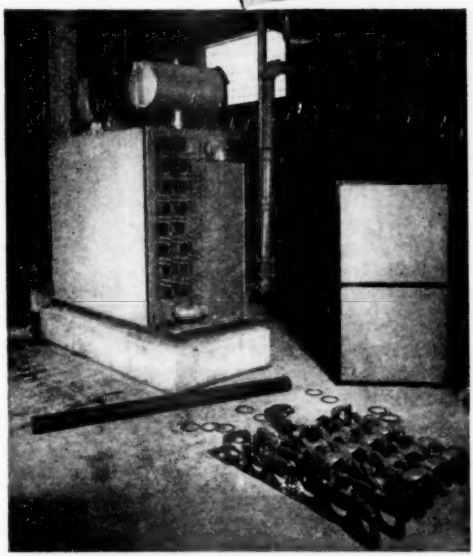

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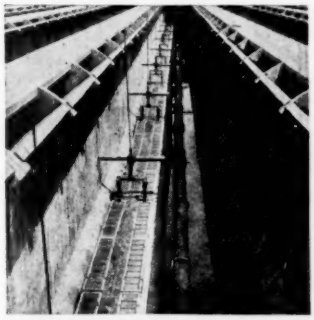

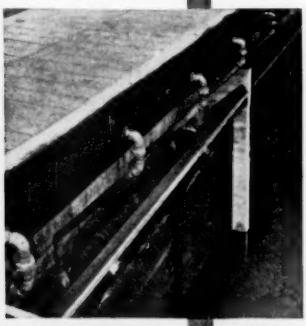

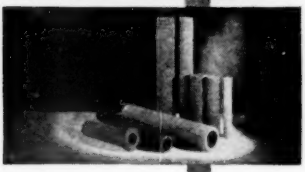

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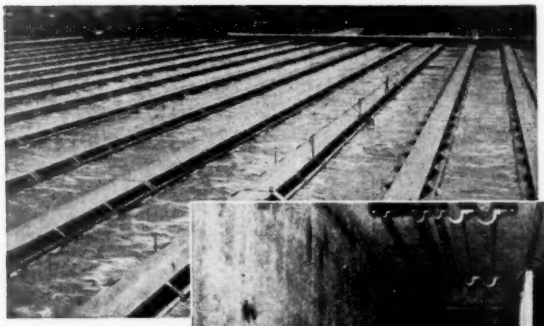

Everdur Electrical Conduit serves the aeration and final settling tanks in bringing power from the operating galleries to the sluice gates of the control centers, and from these centers to the operating mechanism on the center pier of each tank.

Everdur Electrical Conduit in service tunnel looking north from north gallery.

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in World's Largest Sewage Treatment Plant

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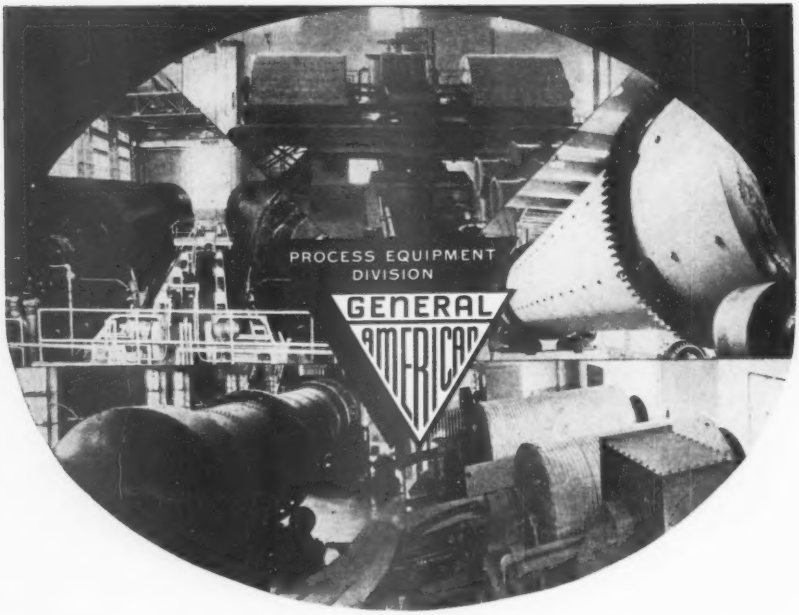

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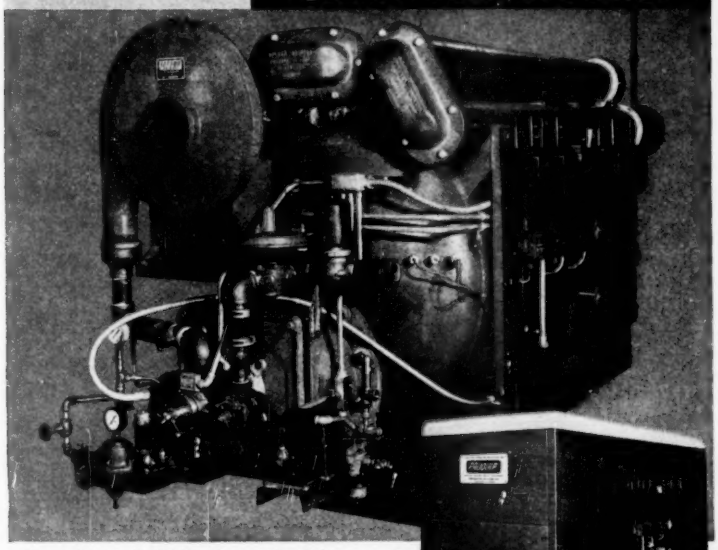

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Requires a minimum of necessary safety controls . . . eliminates all complicated, easy-to-get-out-of-order "gadgets".

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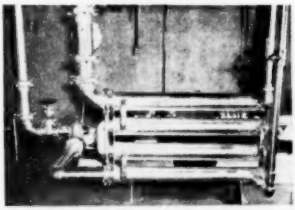
East Lansing, Mich. installation shown completely enclosed.



Walker Process HeatX Unit installation at Webster City, Iowa

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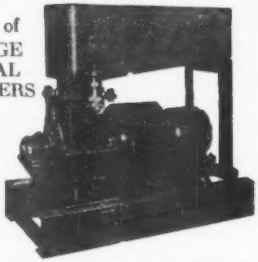

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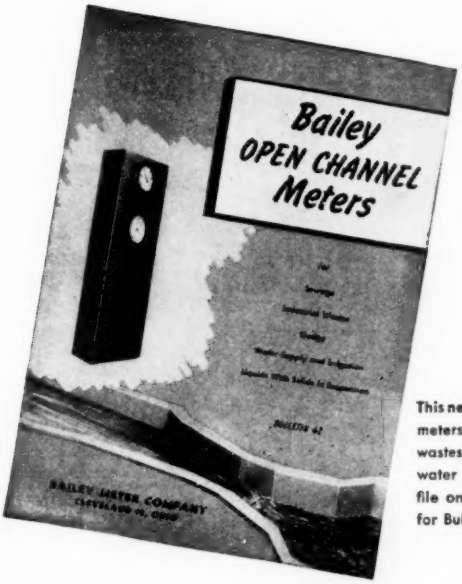

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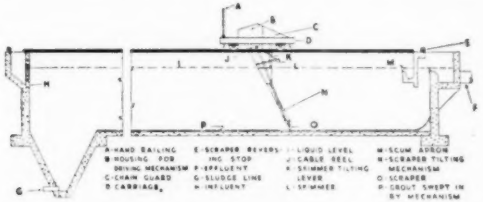

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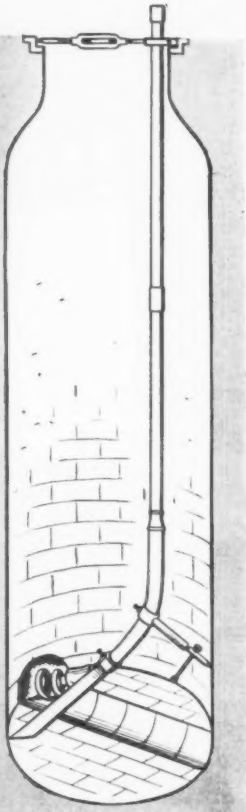

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INDEX TO ADVERTISERS

	Page
Albright and Friel, Inc.	34
Alvord, Burdick & Howson	34
American Brass Company	31
American Cast Iron Pipe Company	2nd Cover
American Cast Iron Pipe Company	1
American Well Works	32
Armco Drainage and Metal Products, Inc.	30
Bailey Meter Company	41
Baxter, Nelson & Wendnagel	34
Black and Veatch	36
Bogert, Clinton L., Associates	34
Bowe, Albertson & Associates	34
Brown Instrument Company	31
Buck, Seifert & Jost	35
Builders-Providence, Inc.	3
Burgess & Niple	34
Burns & McDonnell Engineering Company	35
Camp, Dresser & McKee	33
Capitol Engineering Corporation	35
Cast Iron Pipe Research Association	28
Chain Belt Company	12–13
Chapman Valve Manufacturing Company	9
Chester Engineers, The	35
Chicago Pump Company	4
Clorox Corporation, The	38
Consoer, Townsend & Associates	33
Corson, Oscar	35
De Leuw, Cather & Company	33
Dorr Company, The	26
Economy Pumps, Inc.	42
Electro Rust-Proofing Corp. (M. J.)	42
Everson Manufacturing Corporation	40
Fay, Spofford & Thorndike	33
Flexible Sewer Rod Equipment Company	44
Fulton & Fiedler	35
Gannett Fleming Corddry & Carpenter, Inc.	33
General American Transportation Corporation	22
General Chemical Division (Allied Chemical & Dye Corp.)	23
Gilbert Associates, Inc.	35
Glace, Ivan M.	35
Goff, Inc., William A.	34
Greeley & Hansen	33
Gruendler Crusher and Pulverizer Company	40
Hardinge Company, Inc.	43
Havens and Emerson	34
Hayden, Hawkins & Buchanan	35
Horner & Shifrin	34
Infilco, Inc.	11
Jeffrey Manufacturing Company	17
Johns-Manville Corporation	6
Jones, Henry & Schoonmaker	35
Kelk & Holroyd	34
Kennedy, Clyde C.	34
Knowles, Inc., Morris	35
Koppers Company, Inc.	39
Link-Belt Company	7
Lowe, William S., Company	34
Magnetite Filter Corporation	40
Metcalf & Eddy	33
National Clay Pipe Manufacturers, Inc.	29
Nichols Engineering & Research Corporation	35
Nordstrom Valve Division (Rockwell Manufacturing Company)	15
Norton Company	39
Pacific Flush Tank Company	37
Parsons, Brinckerhoff, Hall & Macdonald	34
Phelps, Inc., Boyd E.	37
Pitnie Engineers, Malcolm	37
Portland Cement Association	10
Ripple and Howe	37
Rockwell Manufacturing Company	15
Russell and Axon	37
Simplex Valve and Meter Company	5
Stanley Engineering Company	37
Stilson & Associates, Alden E.	37
U. S. Pipe and Foundry Company	25
Vapor Recovery Systems Company	18
Walker Process Equipment, Inc.	21
Wallace and Tiernan Company	3rd Cover
Weston & Sampson	37
Whitman, Requardt & Associates	37
Wood Company, R. D.	4
Yeomans Brothers Company	19

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